MANUAL

INSTALLATION | OPERATION | MAINTENANCE

DIGITAL VALVE POSITIONER FY500

HART® COMMUNICATION PROTOCOL

AUG/22 - VERSION 1

smar
Technology Company

FY500

Digital Valve Positioner

Consult our subsidiary

Rua Dr. Antônio Furlan Junior, 1028 - Sertãozinho, SP - CEP: 14170-480
insales@smar.com.br | +55 (16) 3946-3599 | www.smar.com

smar
Technology Company

GENERAL

This operation and maintenance instruction manual provides installation, operating, calibration, and maintenance information for the FY500.

The FY500 must only be installed, operated, and maintained by qualified personnel with fully trained in field equipment installation.

For additional assistance or if there is any question concerning the instructions, contact SMAR.

Modifying this product, substituting non-factory parts, or using maintenance procedures other than outlined could drastically affect performance and be hazardous to personnel and equipment, and may void existing warranties.

NOTE
This manual is compatible with version 1.XX, where 1 indicates software version and XX software release. The indication 1.XX means that this manual is compatible with any release of software version 1.

SAFETY TERMS

To avoid personal injury or property damage, WARNING and CAUTION notes must be strictly followed. Always follow the standard industry safety practices and cautions when working on this or any process control product.

Refer to the appropriate instruction for hazardous area.

WARNING
Throughout the operation of the positioner, including self setup, do not touch the moving parts of the valve/actuator/positioner set as they may unexpectedly move. Do not remove FY500 from the valve while the valve is still pressurized. Make sure to disconnect the electric power, control signal, or air supply before touching any moving parts. Check with the process or safety engineer for any additional measures that must be taken to protect the process.

UNPACKING AND STORAGE

Although Smar takes steps to prevent damage in transport, such damage is possible and must be discovered and reported before installing the FY500. Do not install the positioner that has been damaged in transport or during storage.

Waiver of responsibility

The contents of this manual abides by the hardware and software used on the current equipment version. Eventually there may occur divergencies between this manual and the equipment. The information from this document are periodically reviewed and the necessary or identified corrections will be included in the following editions. Suggestions for their improvement are welcome.

Warning

For more objectivity and clarity, this manual does not contain all the detailed information on the product and, in addition, it does not cover every possible mounting, operation or maintenance cases.

Before installing and utilizing the equipment, check if the model of the acquired equipment complies with the technical requirements for the application. This checking is the user's responsibility.

If the user needs more information, or on the event of specific problems not specified or treated in this manual, the information should be sought from Smar. Furthermore, the user recognizes that the contents of this manual by no means modify past or present agreements, confirmation or judicial relationship, in whole or in part.

All of Smar's obligation result from the purchasing agreement signed between the parties, which includes the complete and sole valid warranty term. Contractual clauses related to the warranty are not limited nor extended by virtue of the technical information contained in this manual.

Only qualified personnel are allowed to participate in the activities of mounting, electrical connection, startup and maintenance of the equipment. Qualified personnel are understood to be the persons familiar with the mounting, electrical connection, startup and operation of the equipment or other similar apparatus that are technically fit for their work. Smar provides specific training to instruct and qualify such professionals. However, each country must comply with the local safety procedures, legal provisions and regulations for the mounting and operation of electrical installations, as well as with the laws and regulations on classified areas, such as intrinsic safety, explosion proof, increased safety and instrumented safety systems, among others.

The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

The field equipment referred to in this manual, when acquired for classified or hazardous areas, has its certification void when having its parts replaced or interchanged without functional and approval tests by Smar or any of Smar authorized dealers, which are the competent companies for certifying that the equipment in its entirety meets the applicable standards and regulations. The same is true when converting the equipment of a communication protocol to another. In this case, it is necessary sending the equipment to Smar or any of its authorized dealer. Moreover, the certificates are different and the user is responsible for their correct use.

Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user's responsibility to know and apply the safety practices in his country.

TABLE OF CONTENTS

Section 1

INSTALLATION

Safety Instructions

This entire section should be read before proceeding with the installation.

- Operating limits are stated in section 3, Technical Characteristics, on this manual.
- The positioner must only be installed, operated, and maintained by qualified personnel with fully trained in field equipment installation.
- Installation in hazardous areas must be in accordance with IEC60079-14 standard.
- Before starting any assembly or disassembly of the actuator/positioner set, the electrical supply and pneumatic supply must be removed. The actuator line must also be emptied. Stay away from moving parts to avoid serious injury.
- When test cycling the actuator and valve assembly by applying pressure to the pneumatic port, be aware that there are moving parts can cause serious injuries.
- The positioner requires instrument air quality, following the best practices for pneumatic installations. Consult the American National Standard "Quality Standard for Instrument Air" (ANSI/ISA S7.0.01 or ISO 8573-1) for detailed information.
- Blow out all piping before connections are made to prevent dirt or debris from entering the positioner. Do not use sealing tape on pneumatic connections. Liquid sealants are recommended for the pipe threads.
- In areas subjected to high relative humidity, the O-rings for the electronic housing covers must be correctly placed and the covers must be completely closed by tighten them by hand until you feel the O-rings being compressed. Do not use tools to tight the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is removed; the circuits are exposed to the humidity.
- The electronic circuit is protected by a humidity proof coating, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts. Sealing methods should be employed on conduit entering of the positioner.

Mounting

The FY500 housing is available in NAMUR and VDI/VDE mounting interfaces. It provides direct mounting to various linear or rotary actuators depending on the actuator mounting method and threaded connection type.

WARNING
The positioner must only be installed, operated, and maintained by qualified personnel with fully trained in field equipment installation.

This product ships with plastic plugs in the conduit entries in an effort to protect the internal components from debris during shipment and handling. Remove plastic plugs only during installation to prevent the intrusion of debris or moisture.

It is the responsibility of the installer, or end user, to install this product in accordance with the national or regional code defining proper practices.

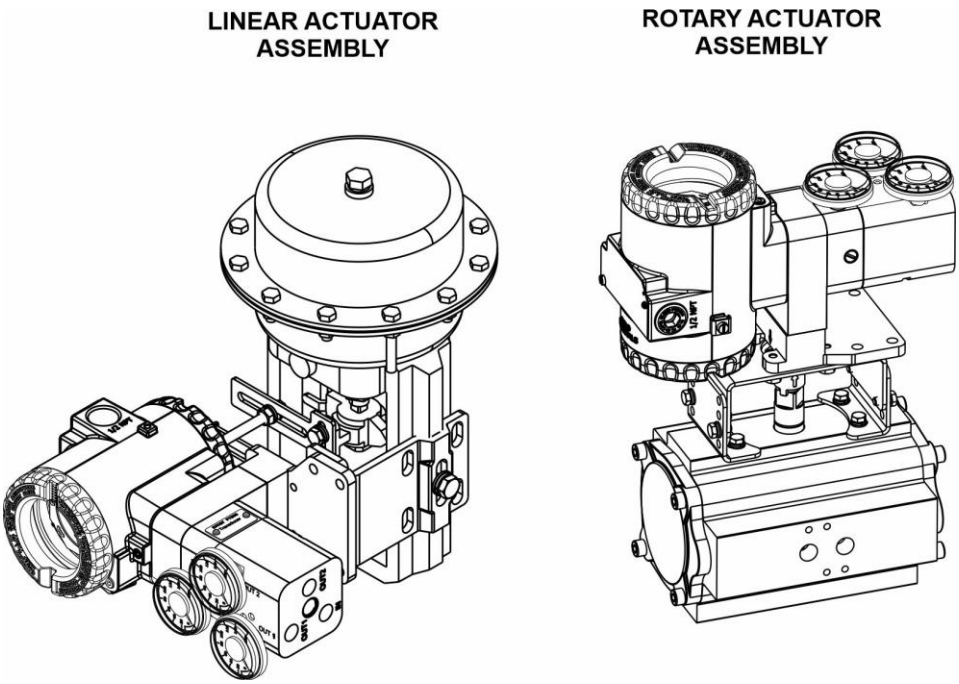

Figure 1.1 – Linear and rotary assemblies

WARNING
Modifying this product, substituting non-factory parts or using maintenance procedures other than outlined could drastically affect performance and be hazardous to personnel and equipment, and may void existing warranties.

On loss of instrument signal, valve will open or close. This identifies whether the valve is fully open or fully closed when the input is 0%. When the input current is removed, the FY500 output 1 should drop to zero.

The following procedures are guidelines to NAMUR linear mounting (DIN IEC 60534-6-1) and NAMUR rotary mounting (VDI/VDE 3845) (DIN EN ISO 5211).

Quarter Turn Rotary Actuators

The FY500 can be mounted in any orientation. The mounting parts kit for the quarter turn actuator contains a mounting bracket with NAMUR VDI/VDE 3845 (DIN EN ISO 5211) standard mounting patterns. See figure 1.2 for the different quarter turn rotary actuator sizes.

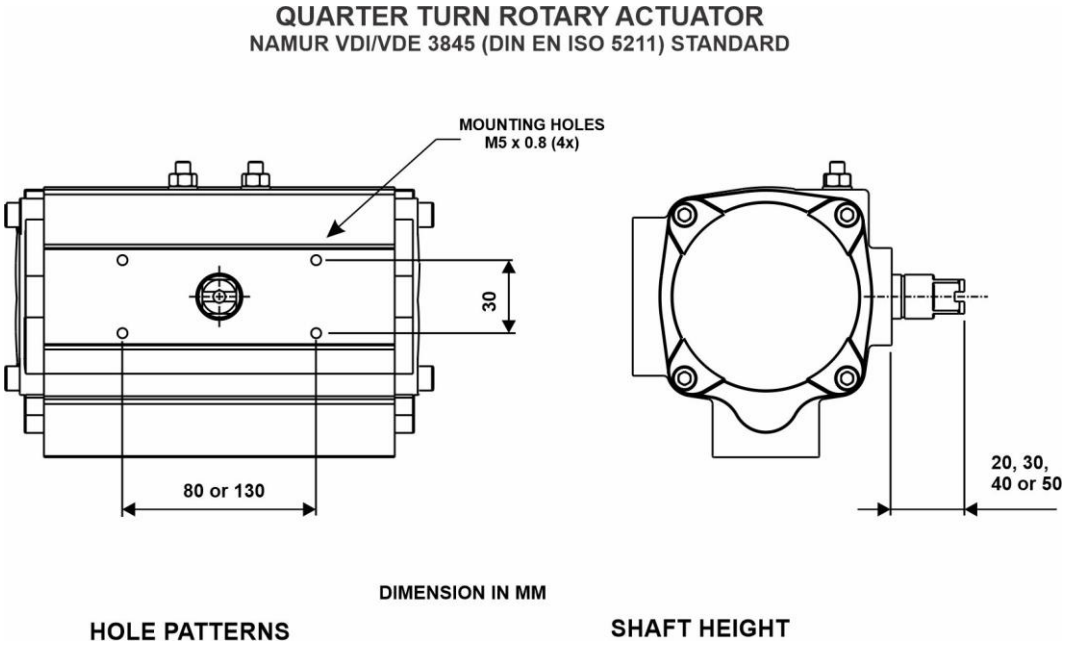

Figure 1.2 – Quarter turn actuator sizes

WARNING
In case of a pneumatic or electrical failure, it is important to know the behavior of the actuator. Before mounting the positioner on an actuator, the failsafe position and direction of rotation of the actuator drive shaft should be verified.

WARNING
Before starting any assembly or disassembly of the actuator/positioner set, the electrical supply and pneumatic supply must be removed. The actuator line must also be emptied. Stay away from moving parts to avoid serious injury.

1. Visually check to make sure the valve is on the fail-safe position. The normal performance of the quarter turn rotary actuators is clockwise-to-close and counterclockwise-to-open. However, this may be inverted under request.

2. Position the rotary actuator to its approximately mid-travel position, using a handwheel or manual loading regulator.

3. The rotary mounting bracket consists of three parts, which can be adjusted to the actuator by different arrangements. Determine the configuration of the rotary bracket, according to dimensions a specific actuator size, using four M5 screws, four lock washers, and four flat washers. as shown in figure 1.3.

TIP
For ease of assembly, attach the L-shaped parts of the mounting bracket only after installing/screwing the rotary adapter.

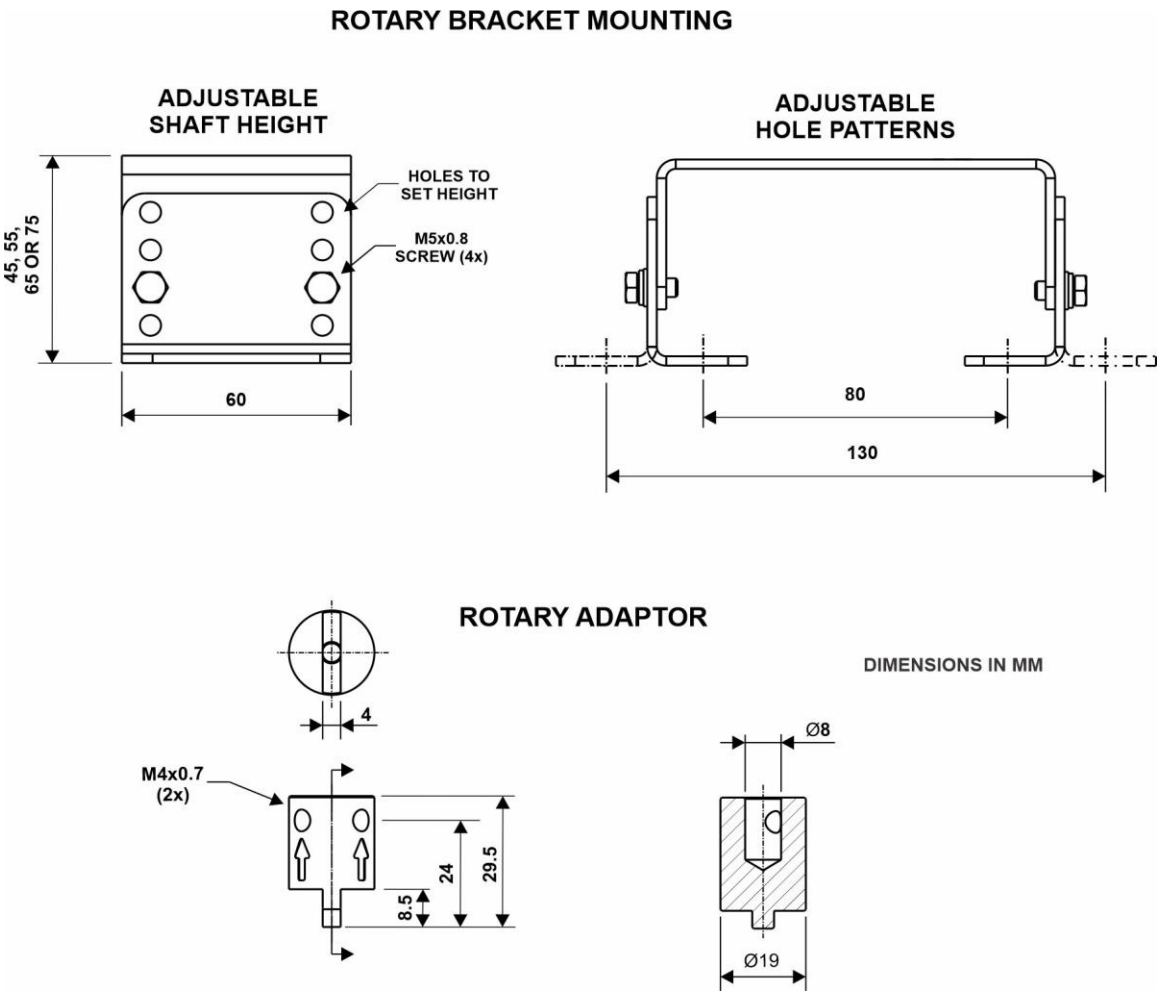

Figure 1.3 – Rotary mounting bracket configuration

4. Before attaching the mounting bracket, determine the orientation of the FY500. It is ‘’IN-LINE’’ to actuator mounting when the pneumatic connections are in the same direction as the longitudinal drive axis of the actuator, or ‘’ACROSS” to actuator mounting when the pneumatic connections are perpendicular direction as the longitudinal drive axis of the actuator.

5. Position the FY500 on the actuator mounting bracket and secure in place with four M6 x 1 bolts. See figure 1.4.

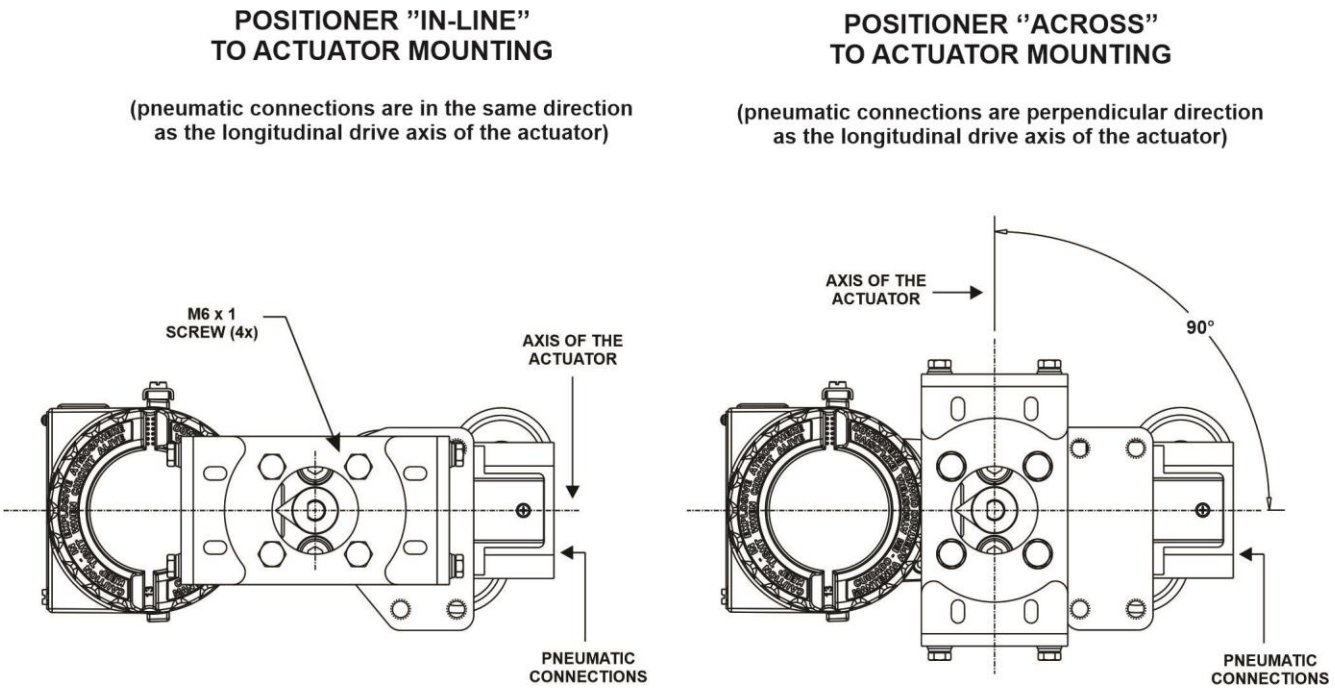

Figure 1.4 – Positioner assembly orientation relative to actuator axis

6. Fit the rotary adaptor onto the feedback shaft of the FY500 and adjust its position on the actuator shaft so that the arrow on the actuator lines up with the arrow mark on the back of the FY500 housing. See figure 1.5.

7. Attach the rotary adaptor to the feedback shaft with one M6 x 10 screw, as shown in figure 1.5. Tighten until the screw fully enters the part.

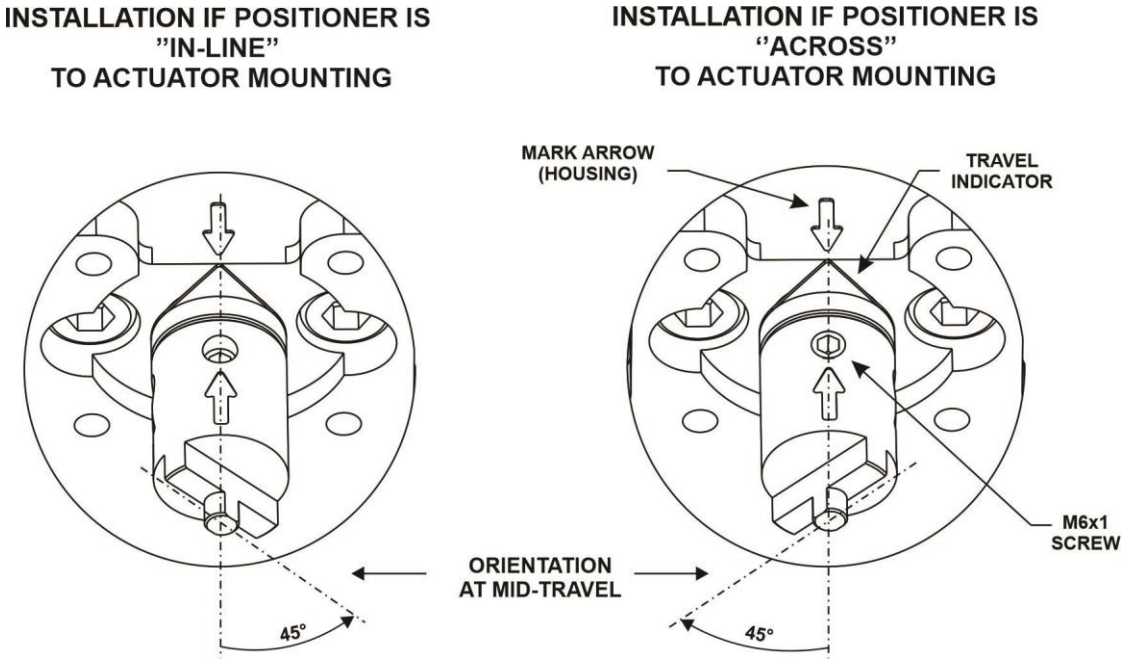

Figure 1.5 – Rotary adaptor assembly orientation on actuator

8. Install the L-shaped parts of the mounting bracket to the FY500, using M6 screws, if not already in place.

9. Install the mounting bracket on the actuator with four M5 x 0.8 screws and flat washers. See figure 1.6. When attaching the FY500 rotary adaptor to the actuator shaft, ensure that the center pin

is fully inserted into the actuator shaft and that the mounting bracket conforms to the configuration shown in figure 1.3.

10. Tighten the mounting bracket screws securely, both those that make it up and those that secure it to the actuator.

WARNING

After installation on the rotary actuator, check that the positioner feedback shaft, adapter and actuator shaft are all aligned. This will avoid friction and other mechanical stresses not designed for parts, increasing their useful life.

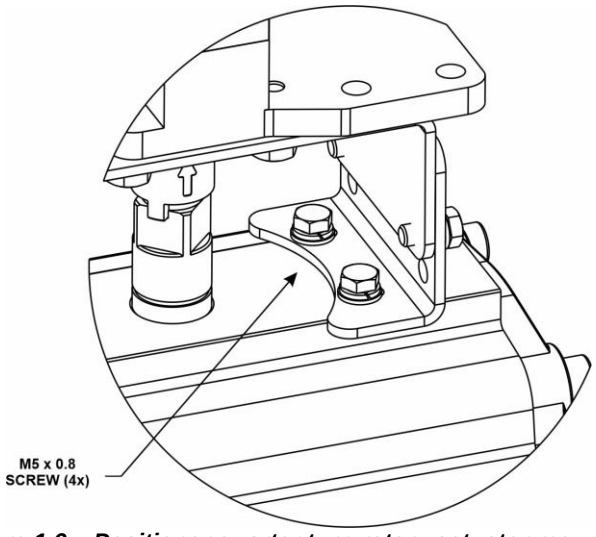

Figure 1.6 – Positioner quarter turn rotary actuator mounting

11. With the actuator at its mid-travel position, the travel indicator is aligned with mark arrow of the housing .

12. Stroke the actuator to each end of its travel. Travel indicator must travel within the admissible range, as shown in figure 1.7.

WARNING

When test cycling the actuator and valve assembly by applying pressure to the pneumatic port, be aware that there are moving parts can cause serious injuries.

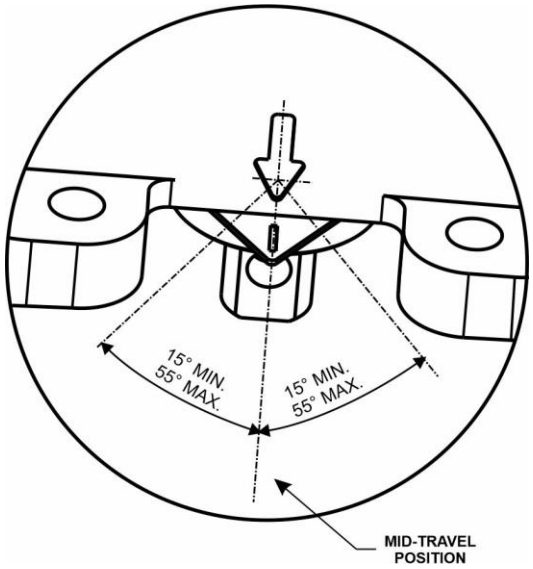

Figure 1.7 – Admissible range – rotary mounting bracket

Linear Actuator

The FY500 can be mounted in any orientation. The mounting parts kit for the linear actuator contains a mounting bracket with NAMUR/IEC 60534-6-1 standard mounting patterns. Applicable to actuators with cast yoke (with rib or plane surface design), or pillar yoke for U-bolt application.

WARNING

In case of a pneumatic or electrical failure, it is important to know the behavior of the actuator. Before mounting the positioner on an actuator, the failsafe position and direction of rotation of the actuator drive shaft should be verified.

The connection between the actuator stem and feedback arm is typically made using a slotted bracket and a feedback pin. There are two ways to transfer the motion through the feedback pin, the **traditional mounting method,** and the **alternate mounting method**.

The Traditional Method

The feedback pin is fixed in the slotted bracket and rides inside the feedback arm.

WARNING

Before starting any assembly or disassembly of the actuator/positioner set, the electrical supply and pneumatic supply must be removed. The actuator line must also be emptied. Stay away from moving parts to avoid serious injury.

1. Attach the feedback pin to the slotted bracket with two M6x1 hex nuts, and two flat washers. Leave the hex nut loose for later adjustment. See figure 1.8.

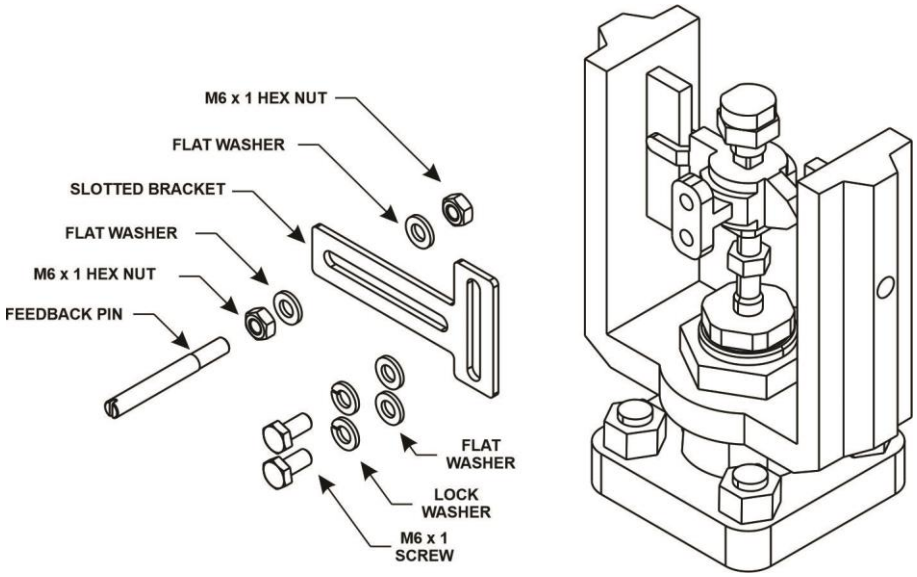

Figure 1.8 – Feedback assembly mounted on actuator stem

2. Attach slotted bracket to the actuator stem with two M6x1 screws, two lock washers, and two flat washers, but do not tighten the fasteners because fine adjustment is required. See figure 1.8.

3. If required, a mounting adaptor is included in the mounting kit. Attach the mounting adaptor to the actuator stem so that the mounting adaptor extends through the yoke leg, then attach the slotted bracket to the adaptor, as shown in figure 1.9. The feedback pin must be on the opposite side of the stem.

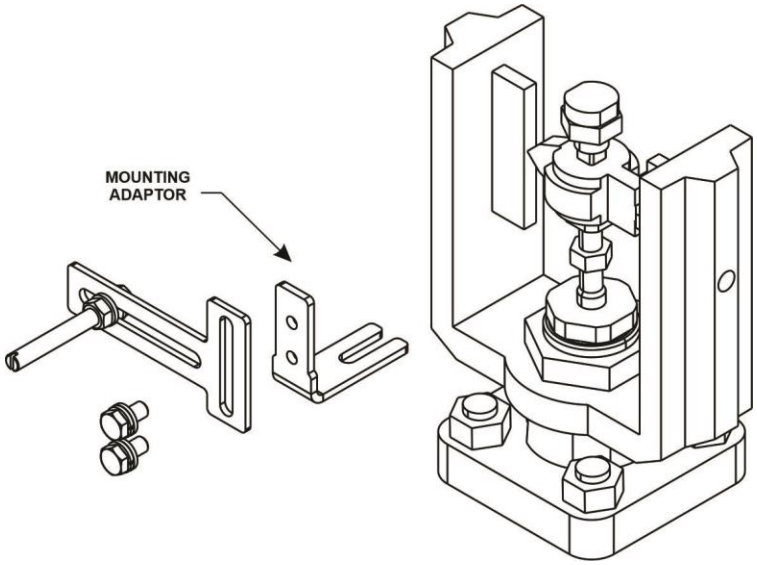

Figure 1.9 – Feedback assembly mounted on mounting adaptor

WARNING

In some cases, attach the slotted bracket to the actuactor stem may not be possible, and an mounting adaptor to actuator stem is required. This adaptor will be shipped to the customers according to their purchase order.

4. The FY500 mounts on linear actuators with up to 200 mm (8 inch) travel. Refer to figure 1.10 for the different travel feedback arm sizes depending upon travel of actuator be used.

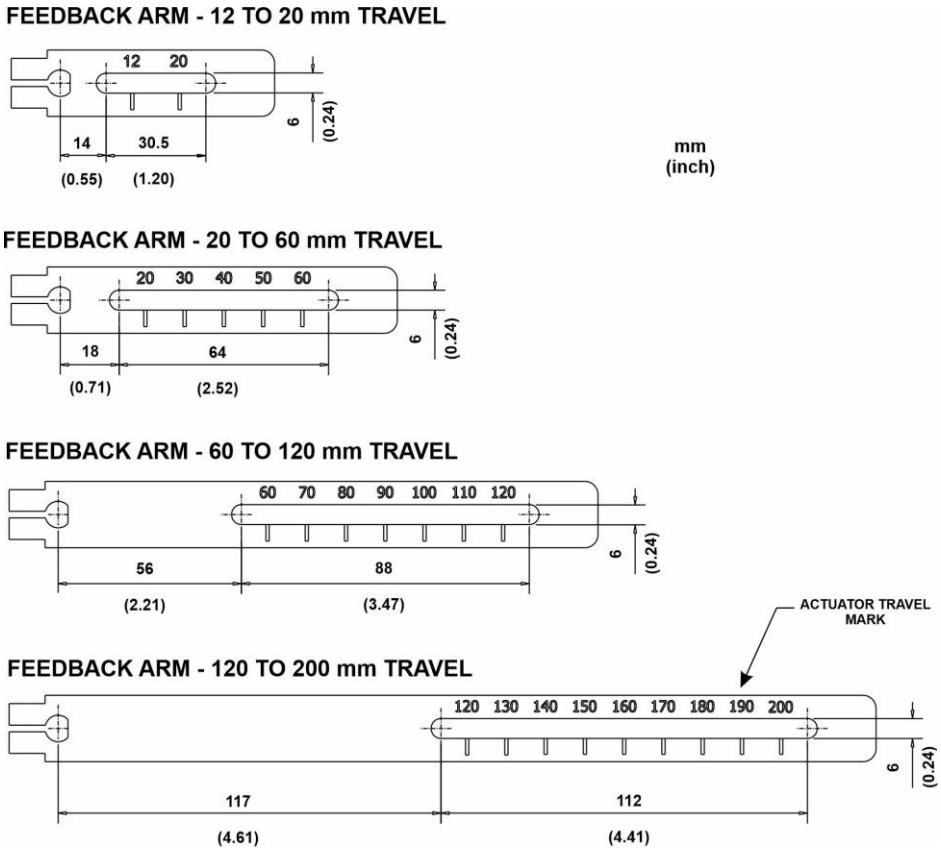

Figure 1.10 – Feedback arm sizes

5. Attach the feedback arm to the end of the feedback shaft with M6x1 screw, M6 hex nuts, lock washers, and flat washers. The markings on the feedback arm must be visible to the operator/installer. Install the compensating spring on the feedback arm. See figure 1.11.

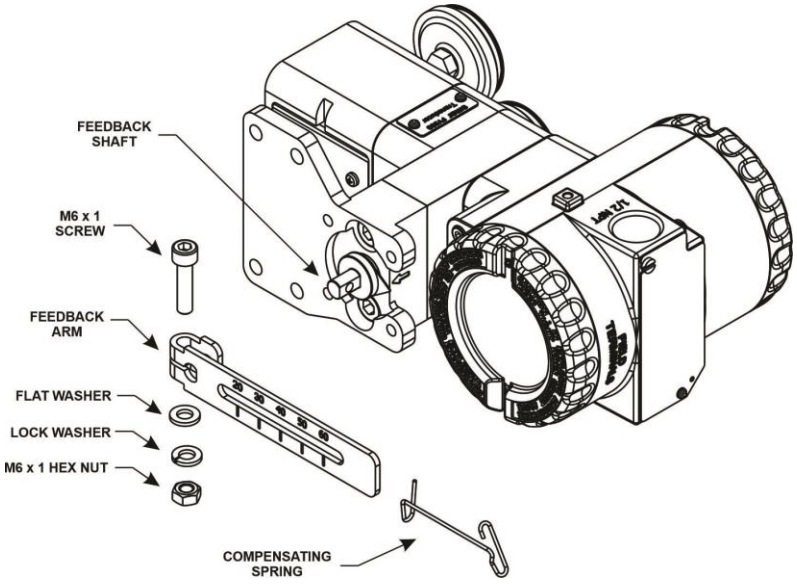

Figure 1.11 – Feedback arm assembly

WARNING

The compensating spring is used to hold the feedback pin securely against one side of the feedback arm slot. This prevents excessive play in the linkage and limits the amount of error introduced into the system through the linkage.

6. Refer to figure 1.12. Mount the positioner to the mounting bracket using two M8x1.25 screws, two lock washers, and two flat washers.

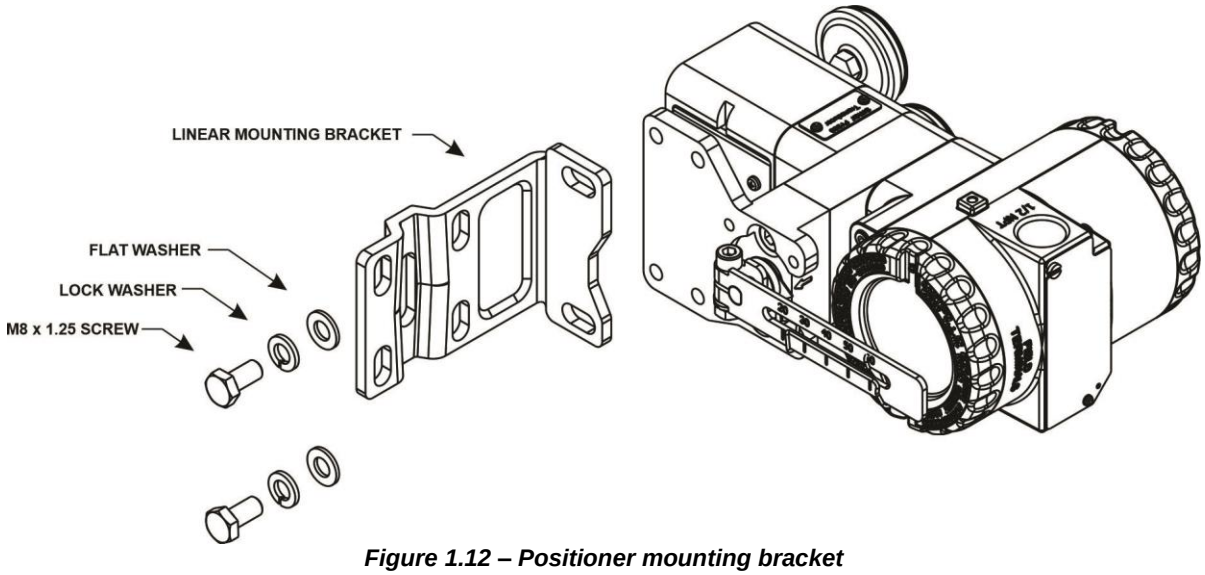

Figure 1.12 – Positioner mounting bracket

7. Position the actuator to its mid-travel position using a handwheel or manual loading regulator.

8. Adjust the vertical position of the slotted bracket so that the feedback arm and oblong arm are horizontally aligned. The feedback pin must be in the mark on the feedback arm that indicates the valve stroke size (see marking on cast yoke). Tighten the M6x1 screws.

9. Before installing the mounting bracket to the actuator yoke, slip the round end of the feedback pin into the feedback arm slot. Make sure the feedback pin engages the slot in the feedback arm.

Secure the mounting bracket to the actuator yoke using the follow procedures:

- **For actuators with cast yoke with rib surface application**, using the M8x1.25 screw, lock washer, and flat washer. See figure 1.13.

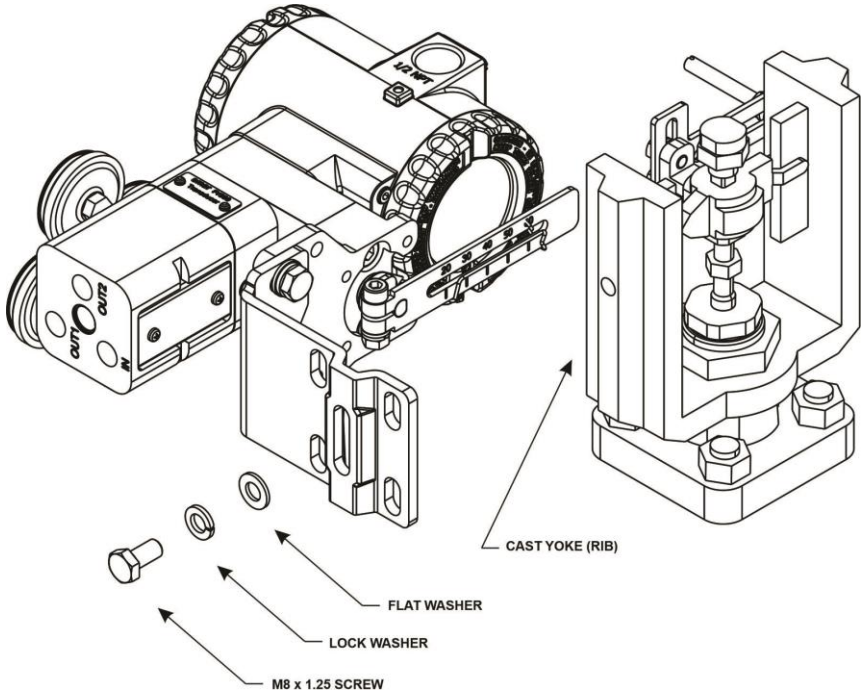

Figure 1.13 – Attachment to cast yoke with rib surface

- **For actuators with cast yoke with plane suface application**, using two 5/16 – 18 UNC screws, two lock washers, and two flat washers. See figure 1.14.

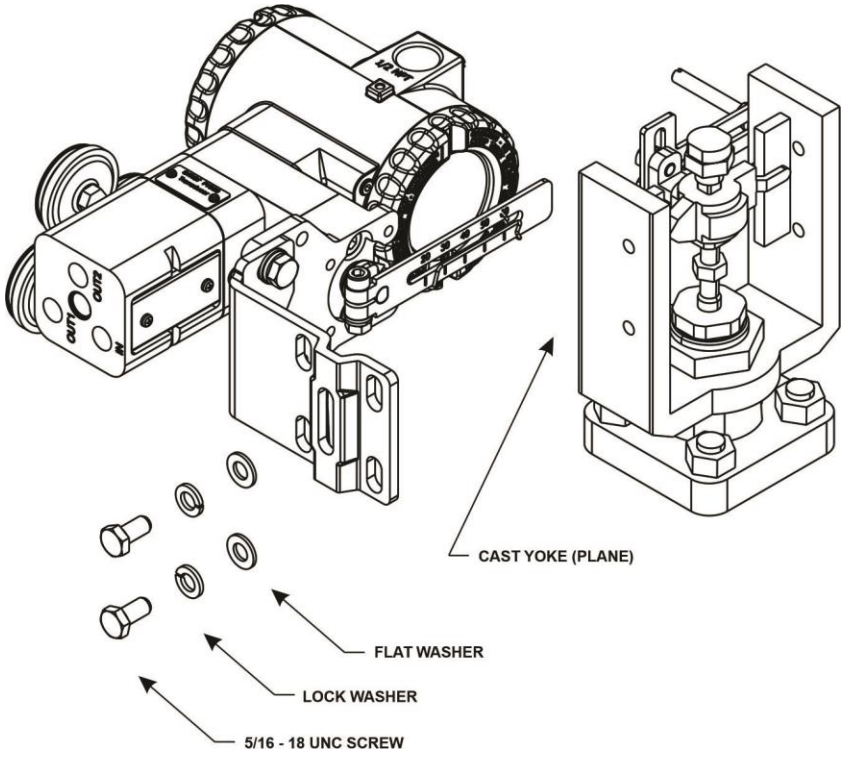

Figure 1.14 – Attachment to cast yoke with plane surface

- **For actuator with pillar yoke for U-bolt application**, using two U-bolt, four lock washers, and four flat washers, as shown in figure 1.15.

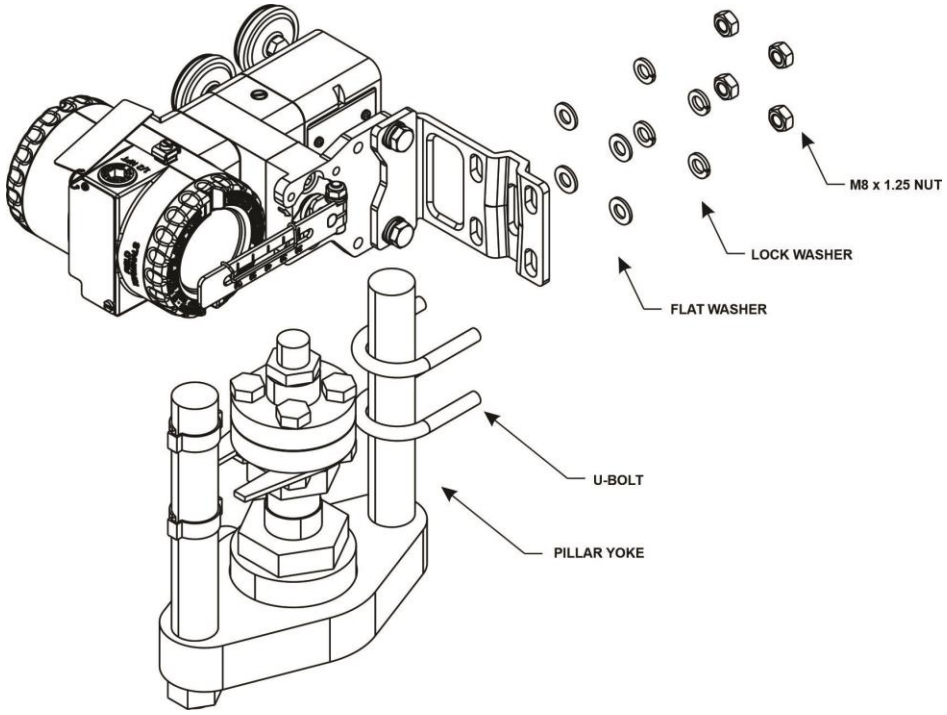

Figure 1.15 – Attachment to pillar yoke for U-bolt

10. Slide the adjustment feedback pin in the slot of the slotted bracket until the pin is in line with the desired actuator travel marking on the feedback arm. The compensating spring must be positioned such that the feedback pin sits in the central side of the compensating spring´s slide area. Tighten the hex nuts. As shown in **figure 1.16**.

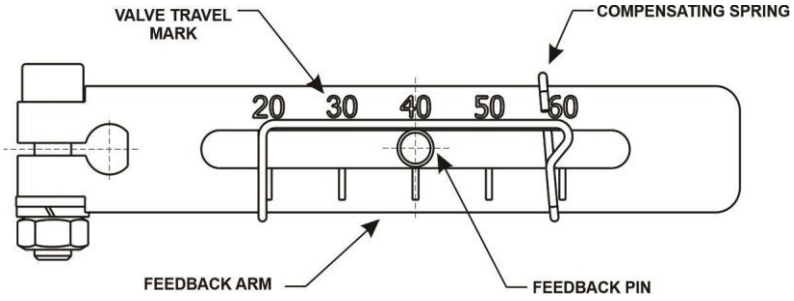

Figure 1.16 – Positioning feedback pin in feedback arm

11. With the actuator at its mid- travel position, adjust the mounting bracket location vertically so that the feedback arm is perpendicular to the stem, as shown in figure 1.17.

12. Stroke the actuator from the top stop to the bottom stop. Travel indicator must travel within the admissible range. See figure 1.17.

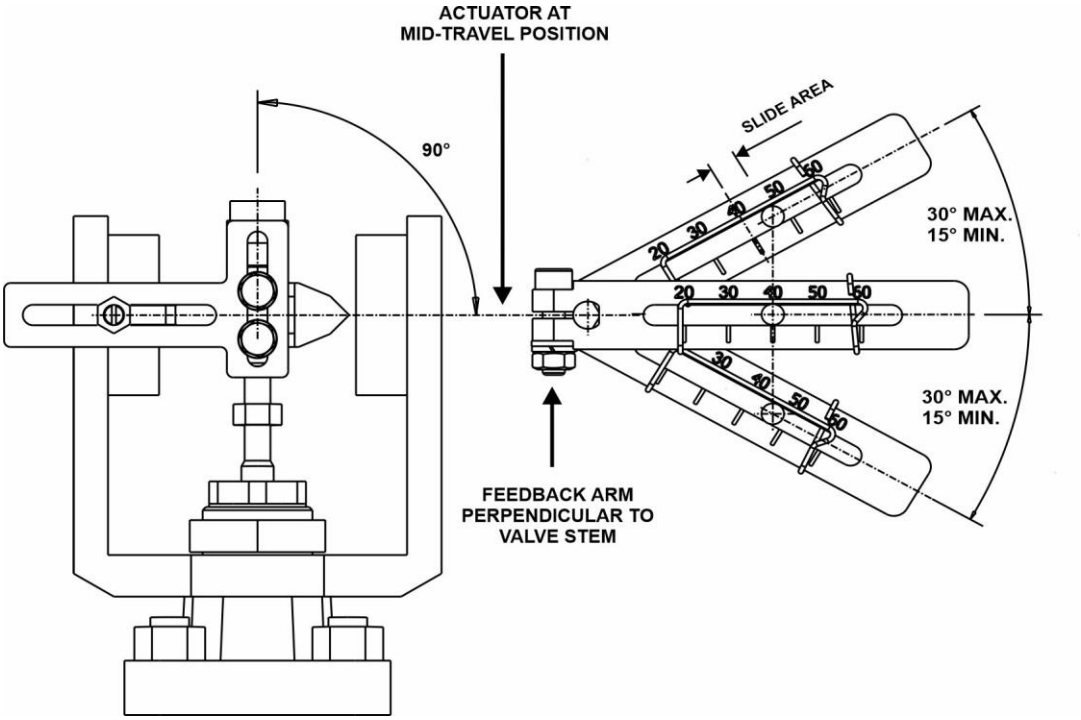

Figure 1.17 – Admissible range – linear mounting bracket

WARNING

When test cycling the actuator and valve assembly by applying pressure to the pneumatic port, be aware that there are moving parts can cause serious injuries.

The Alternate Method

The feedback pin is fixed in the feedback arm and have it ride freely inside the slotted bracket.

WARNING

Before starting any assembly or disassembly of the actuator/positioner set, the electrical supply and pneumatic supply must be removed. The actuator line must also be emptied. Stay away from moving parts to avoid serious injury.

1. Install the compensating spring on the slotted bracket.

2. Attach the feedback pin to the feedback arm with two M6x1 hex nuts, and two flat washers. Adjust the position of the feeback pin so that the center aligns with the appropriate travel mark on the feedback arm.

3. Complete the assembly procedure described in **The Traditional Method** topic of this manual.

Pneumatic Connections

The FY500 requires instrument air quality, following the best practices for pneumatic installations. Consult the American National Standard “Quality Standard for Instrument Air” (ANSI/ISA S7.0.01 – 1996) for detailed information. Instrument air shall the following characteristics:

Dew point	10ºC below minimum instrument temperature.
Size of particles	40 µm (maximum).
Oil content	1 ppm w/w (maximum).
Contaminants	Free of corrosive contaminants and hazardous gases.

The instrument air quality shall be superior to that of industrial compressed air. Humidity, suspended particles and oil contamination, even lubricating oil, may impair the instrument operation, either temporarily or permanently in case of internal parts wearing.

The mentioned standard recommends to place the compressor intake in an environment free from process spills, contaminants, and to use adequate filters. Also, the compressors must be of non-lubricated type to prevent the present of lubrificants. When using lubricated compressors, the plant must have resources to remove the lubricant from the instrument air supplied.

The supply pressure varies from 2 bar (30 psi) minimum, to 10.3 bar (150 psi) maximum. The FY500 requires sufficient supply pressure to stroke the actuator to each end of its travel.

Maximum allowable air supply pressure to the positioner must not exceed 10.3 bar (150 psi). For actuator pressure refer to the appropriate actuator instruction manual.

WARNING

- Never exceed maximum supply pressure. Injury personnel or damage to the equipment may result.
- Supply pressure to positioner should not exceed actuator maximum pressure rating.
- Blow out all piping before connections are made to prevent dirt, chips, or debris to entering to the positioner.
- Use a pipe sealant sparingly and only on male threads. It is not recommended a sealing tape on pneumatic connections.

The positioner vents the supply medium into the surrounding atmosphere through holes located in the positioner vent cover, as shown in figure 1.18. The positioner does not have an external vent connection. Do not restrict the vent opening. Restricting the vent opening can produce a pressure buildup in the positioner valve spool and degrade positioner performance. Ensure that the housing vent opening is open and free of debris to prevent pressure buildup under the cover.

Connect the power supply to the 1/4 NPT IN connection on the positioner. The output connections 1/4 NPT OUT1 and OUT2 must be connected to the actuator. For best response times use tubing of 3/8- inch minimum size. See figure 1.18.

WARNING

When the input current is removed, the FY500 OUT1 should drop to zero and OUT2 register full pressure.

When using a positioner on a single acting actuator, close OUT2 and connect OUT1 to the actuator pneumatic input.

When using a positioner on a double acting actuator, connect OUT1 and OUT2 to the appropriate actuator pneumatic input. When the input current is removed, the FY500 OUT1 should drop to zero and OUT2 register full pressure.

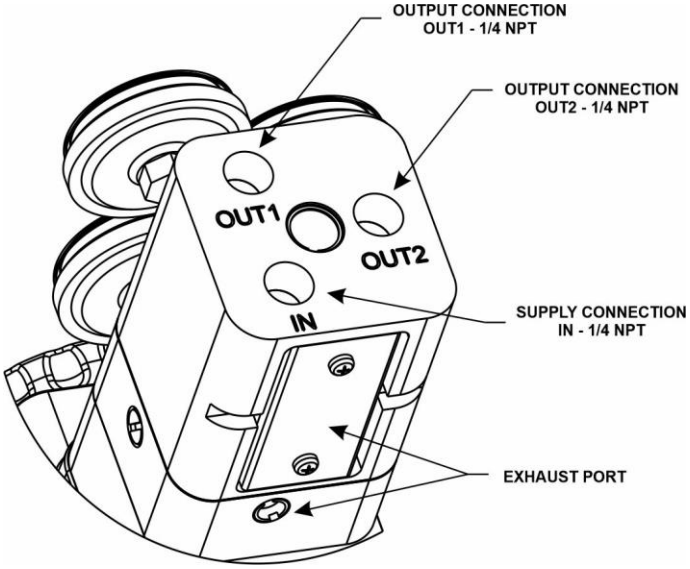

Figure 1.18 – Pneumatic connections

Dimensional Drawings

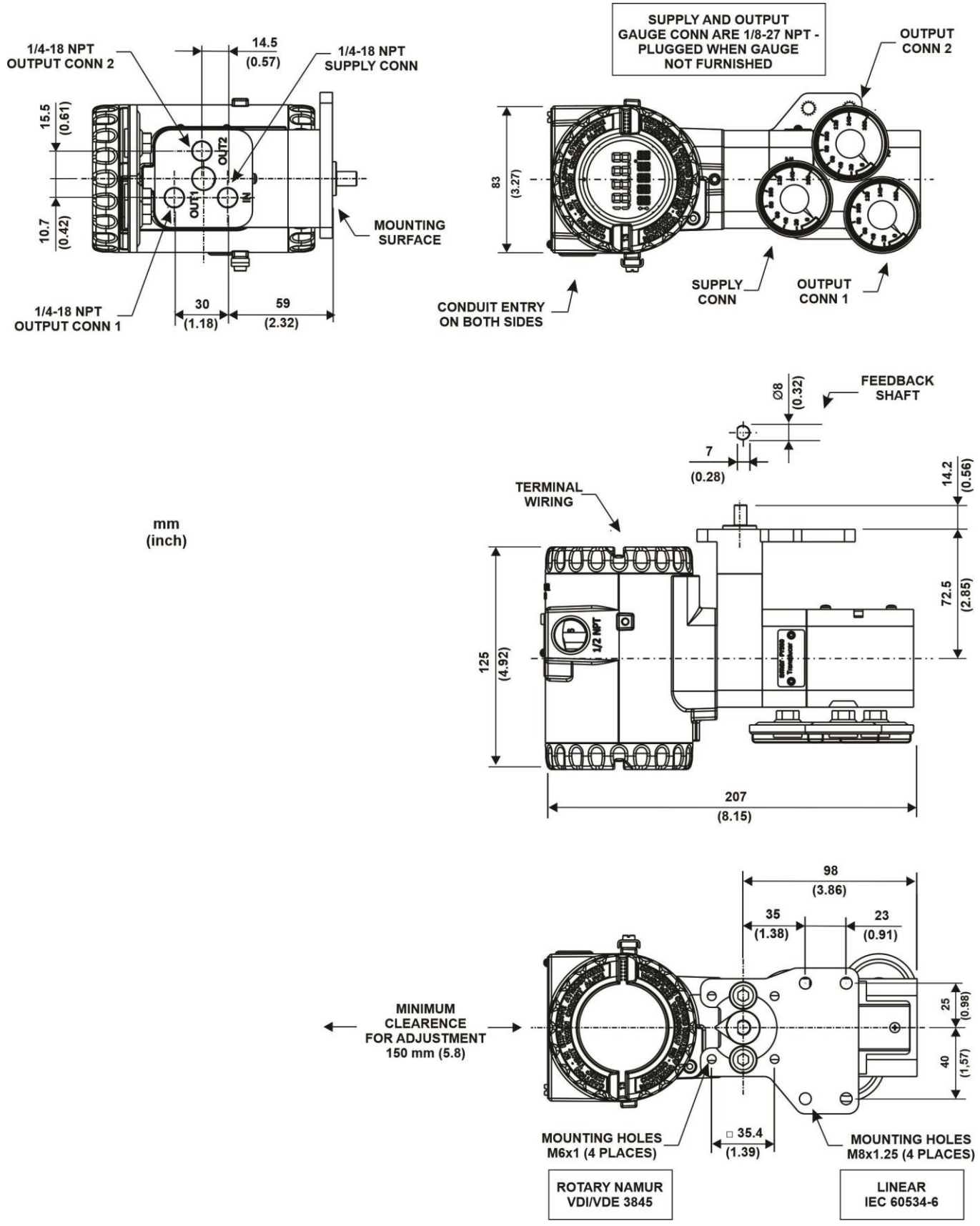

Figure 1.19 – Dimensional drawings

Electrical Wiring

The FY500 is normally powered by a control system output card (PLC). Wire size requirements are 14 AWG maximum, 26 AWG minimum. For environments with high EMI interference levels, the use of shielded cables should be observed. Avoid routing signal wiring near to power cables or switching equipment.

The conduit connection must be sealed according to the hazardous area standards. The unused cable entries should be plugged and sealed accordingly to avoid humidity entering, which can cause the loss of the product's warranty. See figure 1.20.

Use the 1/2 inch NPT (or M20 thread) conduit connection for field wiring installation.

WARNING

In hazardous areas with explosion proof requirements, the covers must be tightened with at least 8 turns. To avoid the penetration of humidity or corrosive gases, tighten the o-ring until feeling it touching the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking bolts.

Conduit threads should be sealed by means of code-approved sealing methods.

The FY500 is designed to withstand explosion proof, non-incendive, and intrinsic safety.

For a complete list of available certificates, please consult **http://www.smar.com**.

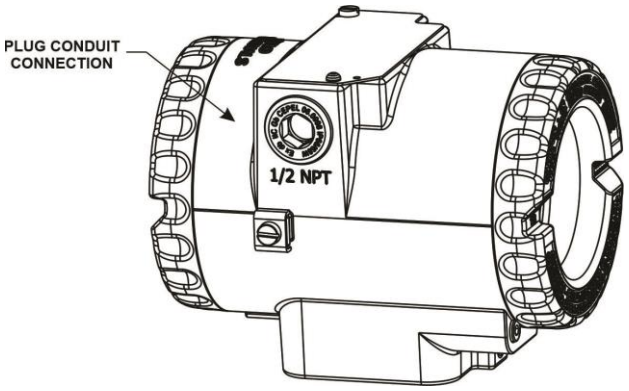

Figure 1.20 – Plug Mounting

4 – 20 mA Loop Connections

The FY500 is normally powered by a control system output card (PLC). Shielded cable will ensure proper operation in electrically noisy environments. Wire the positioner as follows:

1. Loose the cover locking screw and remove the terminal block cover as shown in figure 1.21.

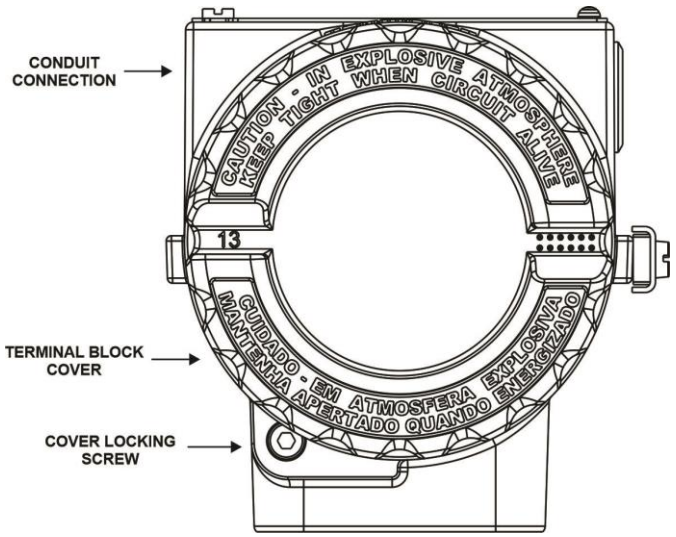

Figure 1.21 – Cover Locking Screw

2. Connect the positive wire to the (+) screw terminal and the negative wire to the (–) screw terminal, As shown in figure 1.22.

3. Two ground terminals are available on electronic housing: one internal and one external. Both are grounded in the housing itself. It is recommended to ground the cable shield at only one end. The cable shielding mesh, if exposed, needs to be insulated so that it does not come into contact with the power supply terminals, for example with heat-shrink tube or insulating tape.

4. Replace and hand tighten the cover. To secure the cover engage the locking screw.

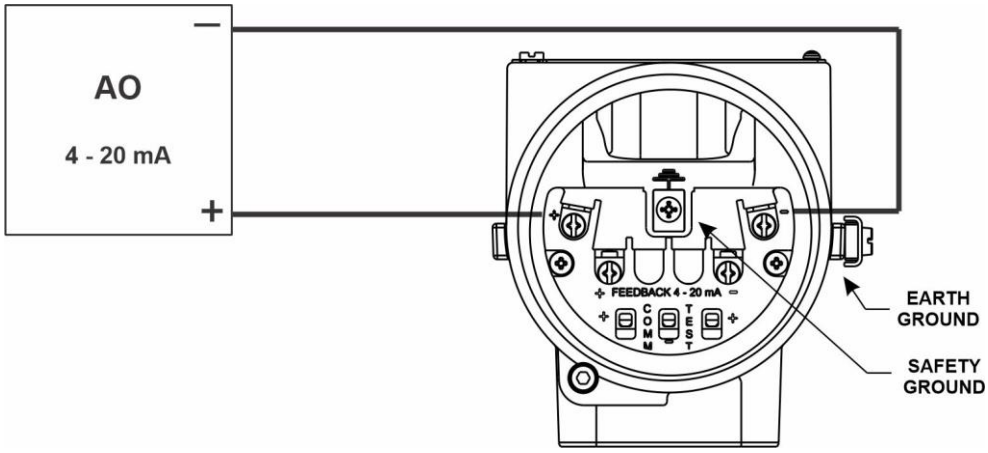

Figure 1.22 – Loop connections

Test Connections

Test terminals allow to measure the current in the 4 - 20 mA loop, without opening the circuit.

1. Remove the terminal block cover as shown in figure 1.21.

2. Connect the positive terminal of the test meter to the (TEST +) and negative terminal of the test meter to the (TEST –). See next figure.

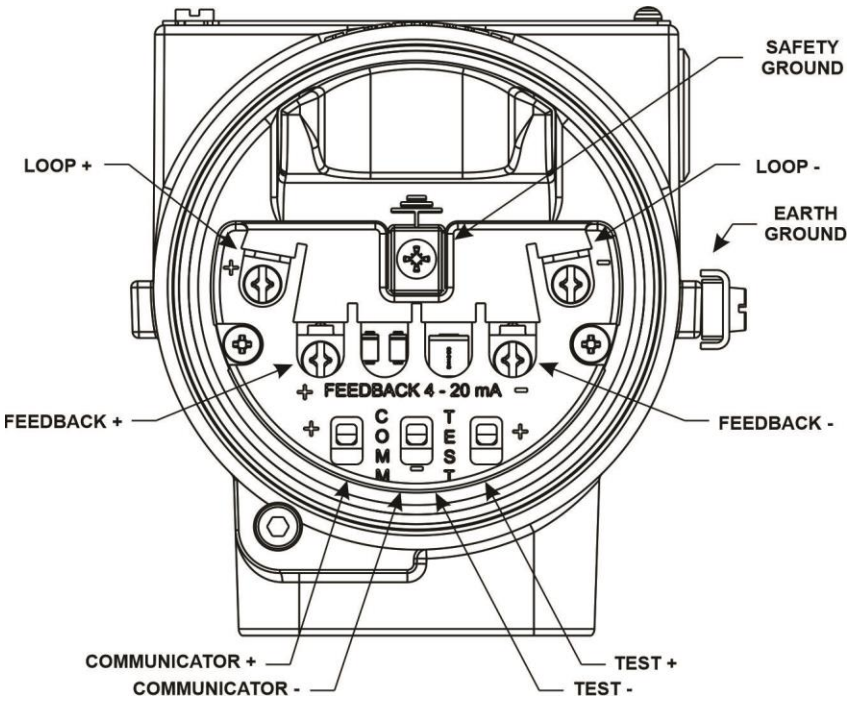

Figure 1.23 – Terminal Block

3. Measure the loop current.

5. Remove test cable. Replace and hand tighten the terminal cover. To secure the terminal block cover engage the locking screw.

Communication Connections

The HART communication interface can be connected to the 4 to 20 mA loop wiring or directly to the appropriate terminals on the FY500 terminal block.

1. Remove the terminal block cover as shown in figure 1.21.

2. Attach the clip-on wires provided with HART interface to COMM terminals, or the (+) and (–) screws terminals, in the FY500 terminal block, ss shown in figure 1.23.

3. After the configuration, remove the clip-on wires. Replace and hand tighten the terminal cover. To secure the terminal block cover engage the locking screw.

Feedback Connections

1. Loose the cover locking screw and remove the terminal block cover as shown in figure 1.21.

2. Connect the positive wire from the control system input card to the FEEDBACK + terminal. Connect the negative wire from the control system input card to the FEEDBACK - terminal. See figure 1.24.

3. Replace and hand tighten the cover. To secure the terminal block cover engage the locking screw.

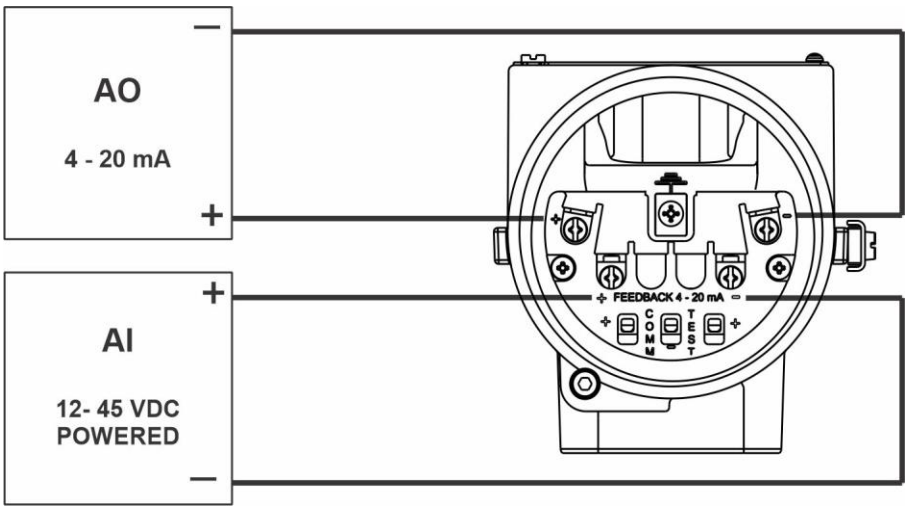

Figure 1.24 – Feedback connections

Electronic Housing Rotation

The electronic housing can be rotated to offer a better display position and/or better access to the field cables.

WARNING
To avoid damage do not rotate the electronic housing more than 270º starting from the fully threaded without disconnecting the electronic circuit from the printed circuit board and from the power supply.

1. Loose the rotation locking screw. See figure 1.25

2. Rotates the electronic housing to the desired position. Observe if the flat cable is not excessively twisted. See figure 1.26.

3. Tighten the rotation locking screw.

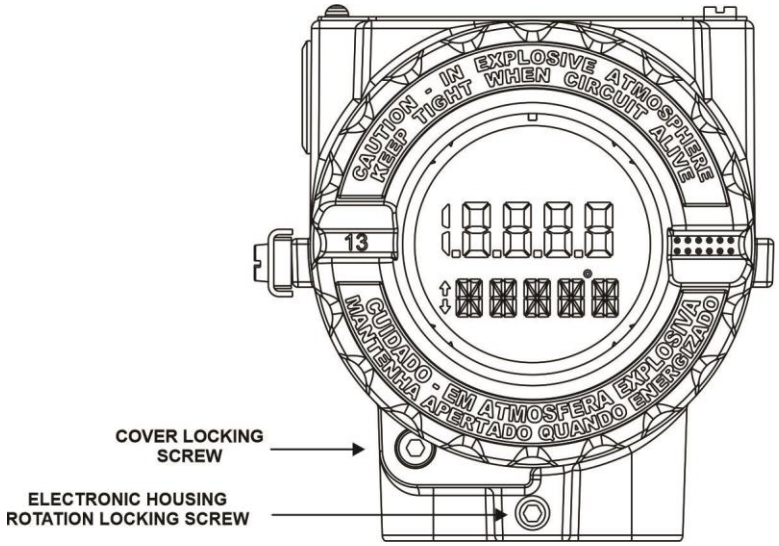

Figure 1.25– Electronic housing rotation locking screw

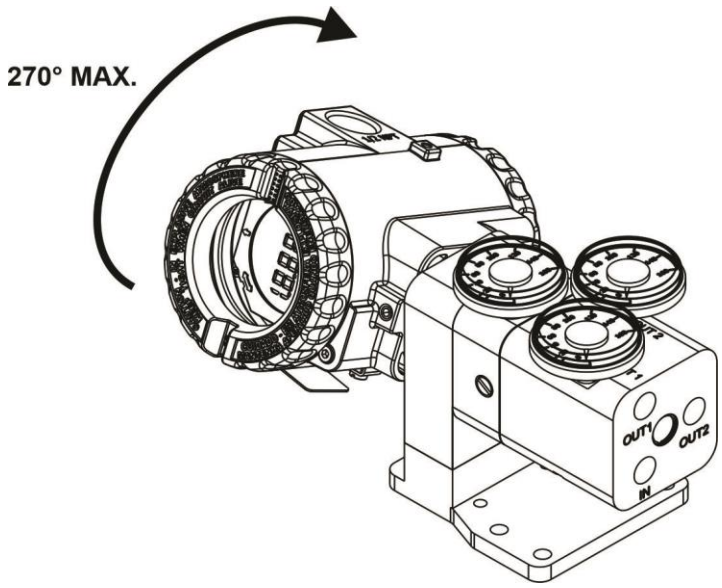

Figure 1.26– Electronic housing rotation

Changing the Display Position

There are four ways to position the display on the housing.

1. Loose the cover locking screw and remove the cover, as shown in figure 1.21.

2. Loosen the four captive display screws and rotates the display to the desire position. The arrow molded into the piece indicates the reading position. See next figure.

3. Tighten the captive display screws. Replace and hand tighten the terminal block cover.

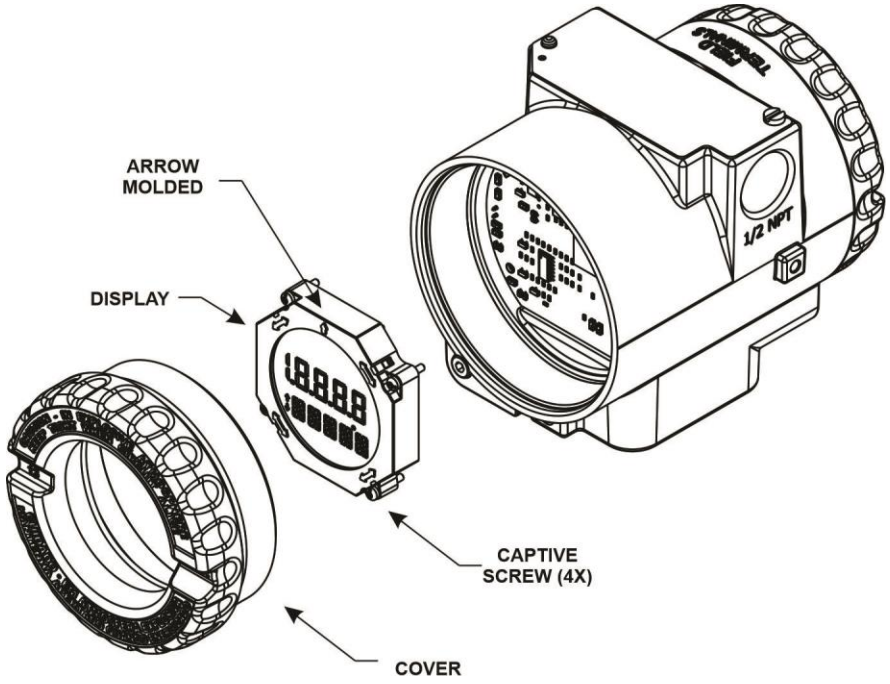

Figure 1.27 – Changing the display position

Typical Applications

The FY500 connection should be done accordingly following applications, as shown in figures 1.28 and 1.29.

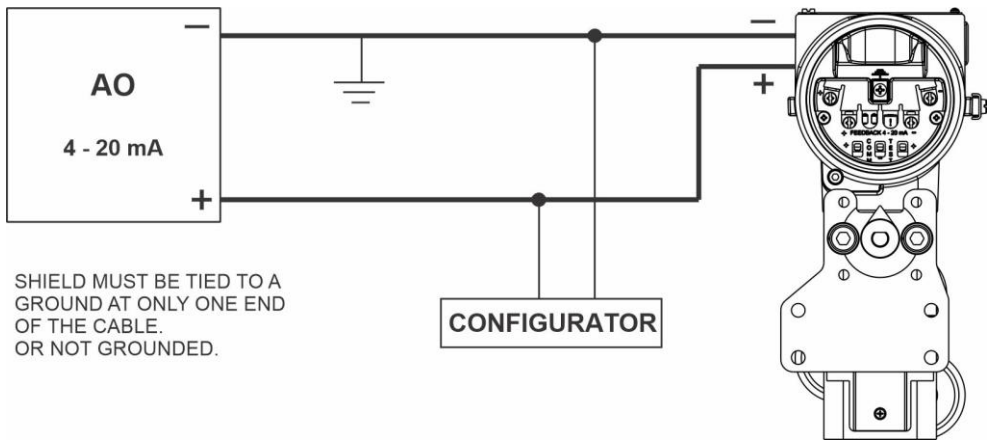

Figure 1.28 – Connecting FY500 to the controller

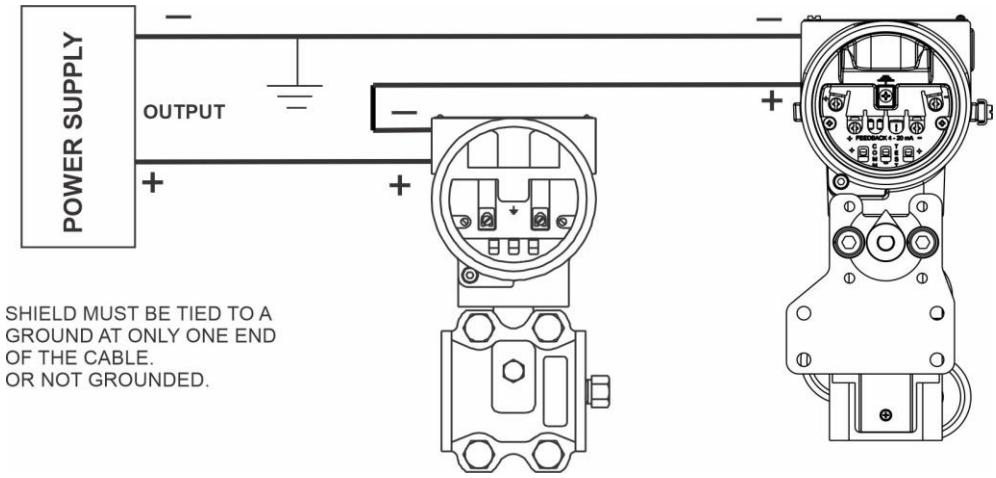

Figure 1.29 – Connecting the FY500 to the pressure transmitter

WARNING
Connect the FY500 to a 4 to 20 mA current source, the positioner will not operate when connected to a voltage source.

Split-Range Operation

The FY500 can be used for split range operation, when a single current output from a control system is used to operate two actuator/valve assemblies. One of the sets will move its entire course between 4 and 12 mA, for example, while the other will do the same from 12 to 20 mA.

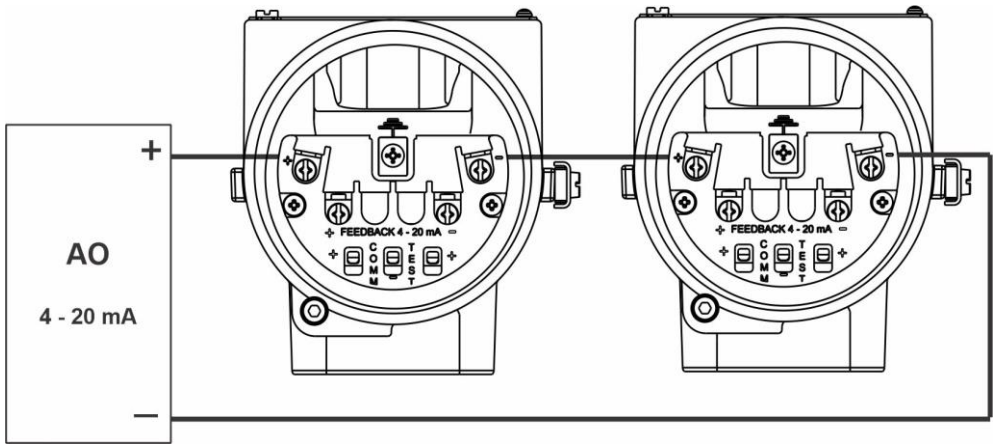

Figure 1.30 – Split range operation

Installation in Hazardous Areas

WARNING

Explosions could result in death or serious injury, besides financial damage. Installation of this positioner in explosive areas must be carried out in accordance with the local standards and the protection type adopted. Before continuing the installation make sure the certificate parameters are in accordance with the classified area where the equipment will be installed.

The instrument modification or parts replacement supplied by other than authorized representative of Smar is prohibited and will void the certification.

The positioners are marked with options of the protection type. The certification is valid only when the protection type is indicated by the user. Once a particular type of protection is selected, any other type of protection cannot be used.

The electronic housing and the position sensor installed in hazardous areas must have a minimum of 6 fully engaged threads. Lock the housing using the locking screw (Figure 1.10).

The cover must be tightened with at least 8 turns to avoid the penetration of humidity or corrosive gases. The cover must be tightened until it touches the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw (Figure 1.10).

Explosion/Flame Proof

WARNING

In Explosion-Proof installations, the cable entries must be connected or closed using metal cable gland and metal blanking plug, both with at least IP66 and Ex-d certification.

As the positioner is non-ignition capable under normal conditions, the statement “Seal not Required” could be applied for Explosion Proof Version.

The standard plugs provided by Smar are certified according to international standards. If the plug needs to be replaced, a certified plug must be used.

The electrical connection with NPT thread must use waterproofing sealant. A non-hardening silicone sealant is recommended.

Do not remove the positioner covers when power is ON.

Intrinsically Safe

WARNING

In hazardous zones with intrinsically safe or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.

To protect the application the positioner must be connected to a barrier. Match the parameters between barrier and the equipment (Consider the cable parameters). Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional. If used, be sure to insulate the end not grounded. Cable capacitance and inductance plus Ci and Li must be smaller than Co and Lo of the associated Apparatus.

For free access to the HART bus in explosive environment, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices. Use only Ex HART communicator approved according to the type of protection Ex-i (IS) or Ex-n (NI).

It is not recommended to remove the positioner cover when the power is on.

NOTE

To obtain all the available certifications consult **www.smar.com**.

OPERATION

Principle of Operation

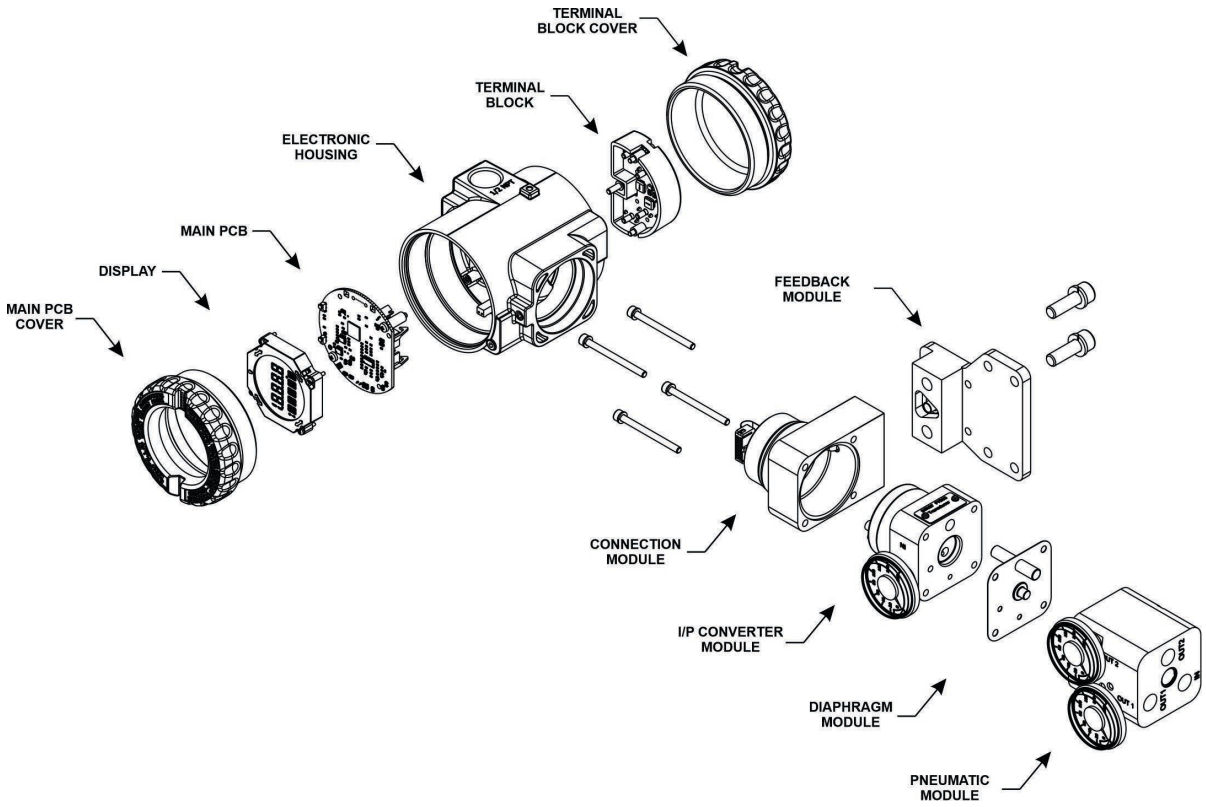

Figure 2.1 – FY500 Digital Valve Positioner (Exploded View)

The FY500 receives a setpoint signal from a controller or other device through a twisted pair of wires. It compares this input signal to the actual valve position, which is measured with a position sensor, in this case, Hall Effect sensor. The difference between the setpoint and the actual position is processed by internal PID, and a corrective current signal is sent to the I/P converter module.

The supply pressure to the FY500 passes through an internal pressure regulator that regulates it to approximately 22 psi. The air then goes through an orifice that restricts the flow and air consumption. The I/P module converts the current signal to a pneumatic signal, which is sent to the diaphragm module and the spool valve. The spool valve directs air supply to the actuator to move the valve until the Hall Effect Sensor reading agrees with the setpoint.

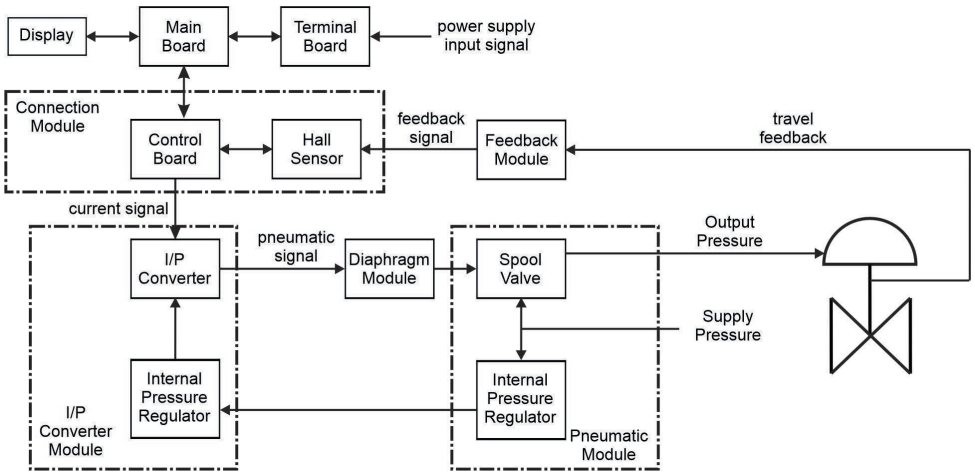

Figure 2.2 – FY500 Block Diagram

Display

The digital display LCD is necessary to show the information, such as measured variable and its unit, and to perform the local adjustment.

During the normal operation, the FY500 stay in the monitoring mode and the display shows the valve position in percentage. During the configuration process, there is an option to show the setpoint on the display. The local programming mode is activated by approximating the magnetic tool to the hole marked by the letter "Z", on the top of the electronic housing.

The Figures 2.3 and 2.4 show the possible configuration indications and monitoring information.

When powering the **FY500**, the display shows the **FY500** model, its firmware version, and the communication protocol.

Monitoring
During normal operation, the **FY500** remains in the monitoring mode. The display on Figure 2.3 shows the valve position in percentage.

On the position marked with “Z”, the magnetic tool moves forward through the programming tree to the next menu item or increments the currently shown value in the digital display. Holding down the magnetic tool causes the value to increase at a faster rate.

On the position marked with “S” the magnetic tool selects or accepts the value or parameter option currently displayed. (More details in the Section 4).

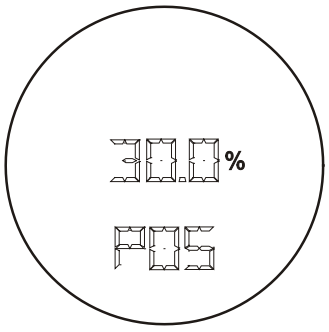

Figure 2.3 – Typical Display

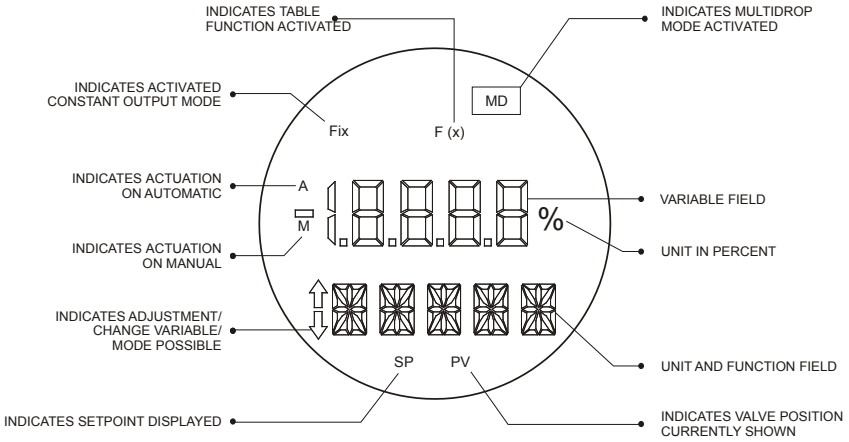

Figure 2.4 – Local Display

Section 3

TECHNICAL CHARACTERISTICS

Functional Specifications

Input and Communication Protocol	**HART®** Two-wire, 4-20 mA Voltage Drop 9.5 Vdc Max / 20 mA (equivalent to 475 Ω) Minimum Control Current: 3.8 mA controlled according to NAMUR NE43 specification, with super-imposed digital HART Protocol.
Humidity Limits	0 to 100% RH (Relative Humidity non-condensable).
Travel	Linear actuator stroke: 12 - 200 mm. Rotary actuator: 30° - 120° Rotation Angle.
Indicator	Rotative LCD, with 4½-numerical digit and 5-character alphanumerical. Function and status icons.
Pressure Supply	2 - 10 bar (30-150 psi). Free of oil, dust, and water, as per ANSI/ISA S7.0.01-1996.
Gauge	For pressure monitoring supply and output, 0 to 160 psi scale. Acrylic display, 304 Stainless Steel connections and flexible parts in Brass.
Flow Characterization	Linear, Equal Percentage, Quick Opening, 16-point freely configurable table.
Temperature Limits	Operation: -40 to 85 °C (-40 to 185 °F). Storage: -40 to 90 °C (-40 to 194 ºF).
Configuration	Through HART digital communication over 4-20mA signal. The FY500 can be configured either via FDT/DTM tools or via DD-based configurators. It can also be configured through local adjustment using Smar's magnetic tool.
Hazardous Area Certifications	Intrinsically safe and explosion proof.
European Directive Information	FY500 is in compliance with the directive. It was designed and manufactured in accordance with good engineering practices using ANSI, ASTM, DIN and JIS standards. Quality Management System audited by BVQI (Bureau Veritas Quality International) for the Management Systems certification. **EMC Directive (2014/30/EU) – Electromagnetic Compatibility** The EMC test was performed according to standard: IEC61326:2002 **ATEX Directive (2014/34/EU) - Explosive Atmosphere, Hazardous Location**

Performance Specifications

Independent Linearity	±0.5% of output span [1,2]
Air Consumption	0.31 scfm (0.49 normal m3/hr) @ 60 psig (4.1 bar) supply pressure) [1]
Output Capacity	11 scfm (20.5 normal m3/hr) @ 60 psig (4.1 bar) supply pressure) [1]
Vibration Effect	Tested per ANSI/ISA-75.13.01 Section 5.3.5.
Ambient Temperature Effect	0.8% / 20ºC of output span [1]
Electromagnetic Interference Effect	Meets IEC 61326:2002

1. Measured according to ANSI / ISA-75.13.01-2013
2. Typical value. Not applicable for ACP mounting brackets applications

Physical Specifications

Electrical Connections	1/2-14 NPT 1/2-14 NPT with 3/4-14 NPT adaptor (AISI316) 1/2-14 NPT with 3/4-14 BSP adaptor (AISI316) 1/2-14 NPT with 1/2-14 BSP adaptor (AISI316) M20x1.5 PG 13.5 DIN
Pneumatic Connections	Supply and Output Pressure: 1/4-18 NPT Gauges: 1/8-27 NPT
Material of Construction	Injected low copper aluminum with polyester painting 316 Stainless Steel housing, with Buna N O-Rings on cover (NEMA 4X, IP66W). Identification Plate: 316 SST.
Mounting	Mounting brackets for linear actuators that comply with IEC 60534-6; and for rotary actuators according VDI/VDE 3845 and NAMUR standards.
Approximate Weights	Without display and mounting bracket: 5.5 kg (316 SST). 2.3 kg (aluminum).

Ordering Code

MODEL														
FY500														
DIGITAL VALVE POSITIONER														
COD	Communication Protocol													
H	HART - 4 to 20 mA													
	COD	Local Indicator												
	1	With local digital indicator												
		COD	Mounting Bracket											
		0	None											
		1	Bracket for rotary actuator - NAMUR and VDI/VDE 3845											
		2	Bracket for linear actuator – stroke length - 12 up to 20mm											
		3	Bracket for linear actuator – stroke length - 20 up to 60mm											
		4	Bracket for linear actuator – stroke length - 60 up to 120mm											
		5	Bracket for linear actuator – stroke length - 120 up to 200mm											
			COD	Electrical Connection										
			0	1/2" - 14 NPT										
			1	1/2" - 14 NPT X 3/4 NPT (316 SST) - with adaptor										
			2	1/2" - 14 NPT X 3/4 BSP (316 SST) - with adaptor										
			3	1/2" - 14 NPT X 1/2 BSP (316 SST) - with adaptor										
			A	M20 x 1.5										
				COD	Type of Actuator									
				1	Single action									
				2	Double action									
					COD	Indication Gauges								
					0	Without pressure gauge								
					1	With 1 pressure gauge – Input								
					2	With 1 pressure gauge - Output 1								
					3	With 2 pressure gauges - Input and Output 1								
					4	With 2 pressure gauges - Outputs 1 and 2								
					5	With 3 pressure gauges								
						COD	Certification Type							
						N	Without certification							
						D	Explosion proof							
						O	Combustible dust							
							COD	Certification Body						
							0	None						
							5	CEPEL						
								COD	Housing Material					
								H0	Aluminum (IP/TYPE)					
								H1	316 SST (IP/TYPE)					
								H2	Aluminum for saline atmosphere (IPW/TYPE X) **(1)**					
								H3	316 SST for saline atmosphere (IPW/TYPE X) **(1)**					
									COD	Manufacturing Standard				
									S0	SMAR				
										COD	Painting			
										P0	Gray Munsell N 6.5 Polyester			
										P8	Without painting			
											COD	Tag Plate		
											J0	With tag		
											J1	Blank		
											J2	According to user´s notes		
												COD	Mount Version	
												R0	Integral Mount	
													COD	Limit Switches
													L0	None
													L1	2 mechanical micro switches
FY500	*	*	*	*	*	*	*	*	*	*	*	*	*	*

TYPICAL MODEL

*Leave it blank if not applicable

NOTE
(1) IPW/TYPEX tested for 200 hours according to NBR IEC 60529 standard.

Section 4

LOCAL PROGRAMMING

Local Adjustment

The local adjustment is available for FY500. The interface consists of a liquid crystal display and magnetic tool. The positioner must be powered with at least 9.6V and 3.8 mA to operate the display. Certain procedures require up to 20 mA of current.

Two jumpers are located on the main board to select the local adjustment (W1 jumper) and write protection (W2 jumper).

Before beginning calibration ensure Local Adjustment jumper is in proper position (ON) on the main board. The factory default is (ON) position.

The local adjustment holes are located below the identification plate.

1. To access the local adjustment, loosen the screw and turn the plate to the side.
2. The hole marked with (Z) allows to move forward through the programming tree to the next menu item or increments the currently shown value in the digital display. Holding down the magnetic tool causes the value to increase at a faster rate.
3. The hole marked with (S) allows to select or accept the value or parameter option currently displayed.

WARNING
Do all changes and configurations very carefully since all modifications in the parameters are recorded automatically and do not need user confirmation to save the configuration.

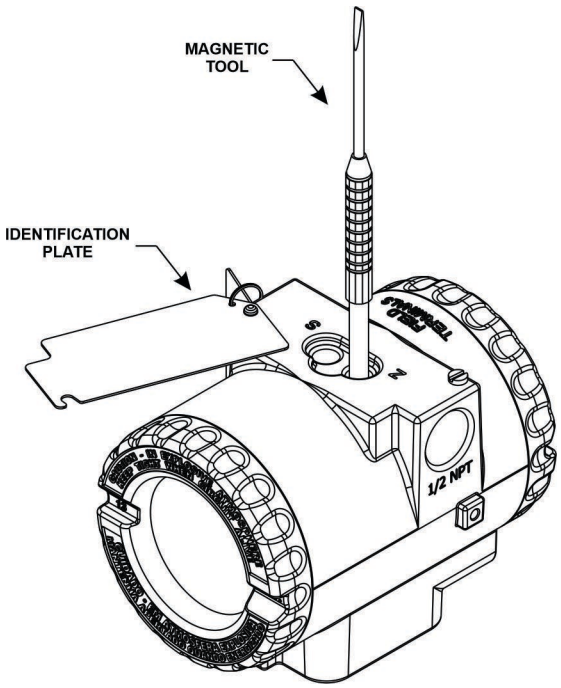

Figure 4.1 – Local Adjustment/Configuration and Magnetic Tool

Jumpers Selection

Two jumpers are located on the main board to select the local adjustment (W1 jumper) and write protection (W2 jumper).

Change the action jumper by setting both jumpers according to Figure 4.2.

Local Adjustment – W1 Jumper

- To select (**ON)**: position the jumper on the **LEFT** side.
- To select (**OFF)**: position the jumper on the **RIGHT** side

Write Protection – W2 Jumper

- To select (**ON**): position the jumper on the **RIGHT** side.
- To select (**OFF)**: position the jumper on the **LEFT** side.

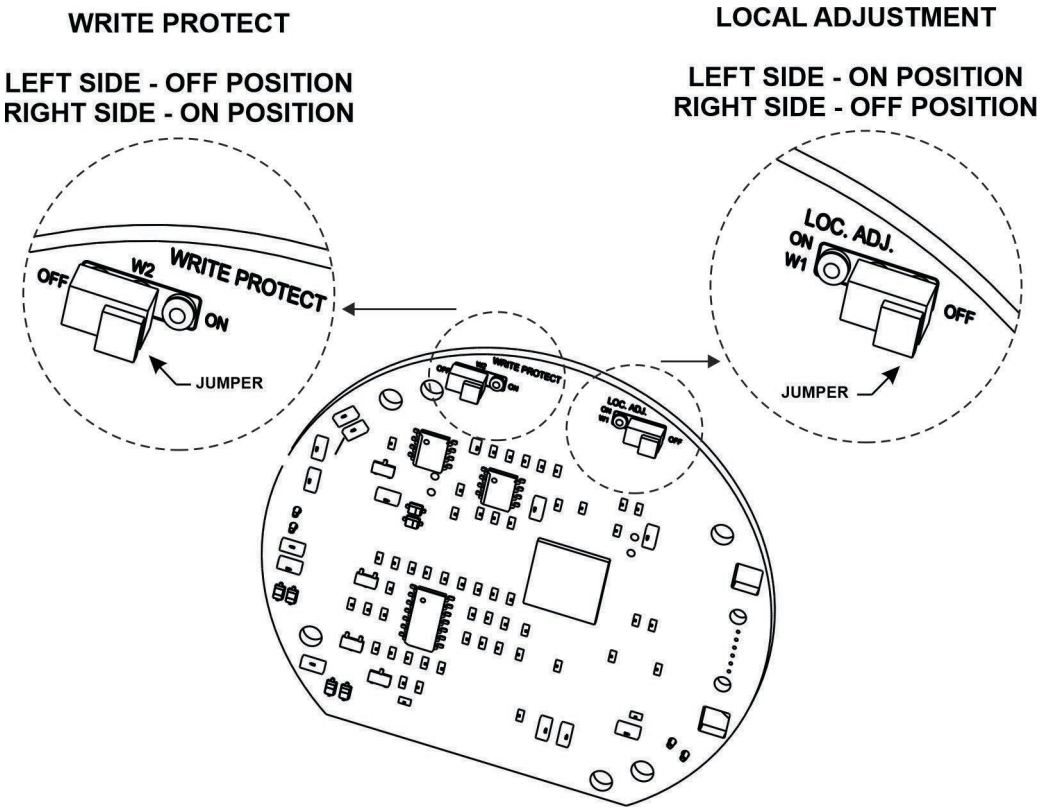

Figure 4.2 – Jumpers on the Main Board

Local Programming Tree

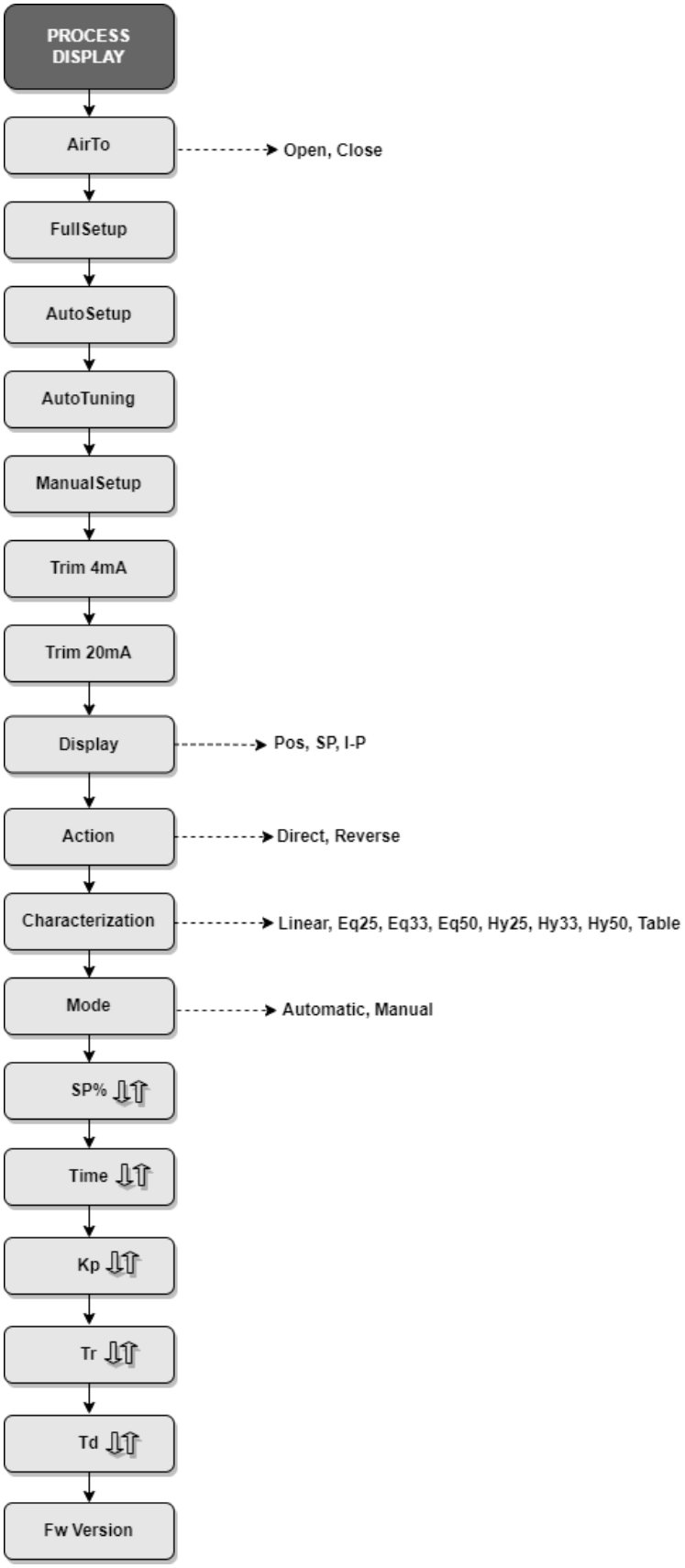

Figure 4.3 – Local Programming Tree

Table 4.1 lists the values that are preconfigured at the factory.

Setup Parameter	Default Setting
AIRTO - Air to Open or Air to Close	Air to Open
ACT – Setpoint action	DIRECT
CHAR - Characterization Curve	LINEAR
MODE - Mode	AUTO
SP % - Set Point	Value read from the process
TIME - Setpoint Variation Time	1 s
Kp - Proportional Gain	3.0
Tr - Integral Time	4.0
Td - Derivative Time	0.5
DISPLAY	PV

Table 4.1 – Factory Default Setting – Local Adjustment

Configurable Parameters

WARNING

Do not touch the moving parts of the valve/positioner/actuator, because they may unexpectedly move automatically.

Below are descriptions of configurable parameters through local adjustment. In parentheses are the ways in which these parameters and their options, if any, appear on the display.

AIRTO (AirTo)
This option allows to adjust the positioner according to the valve actuation. If the actuator works with "air to open" or "air to close", the positioner should be configured for AirTo OPEN**(OP)** or AirTo CLOSE **(CL)**, respectively.

FULL SETUP (Full SETUP)
The FULL SETUP procedure will automatically calibrate and adjust the positioner, including valve travel and positioner PID control parameters. Automatic calibration will provide status information as the procedure is running. Typically, the FULL SETUP takes 3 to 5 minutes to tune the positioner, although tuning FY500 mounted on larger actuators may take longer.

AUTO SETUP (Auto SETUP)
Select AUTO SETUP to automatically calibrate the valve travel. The calibration procedure uses the valve/actuator set stops as the 0% and 100% calibration points. Automatic calibration will provide status information as the procedure is running.

AUTOTUNING (tunE SETUP)
The AUTOTUNING procedure will tune the Kp, Tr, and Td values of the internal PID. Automatic calibration will provide status information as the procedure is running.

MANUAL SETUP (man SETUP)
This procedure allows manual calibration of the travel, allowing to determine the 0% and 100% calibration points. It is possible to calibrate the travel less than the physical travel stops allow.

Executes the AUTO SETUP steps but it needs user confirmation between steps.
The user must confirm the current step conclusion only after completely valve stem stops the movement. The steps are described below:

Step 1:
The positioner acts to send the valve/actuator set to the 0% position. Pressure at output 1 goes to its maximum value and output 2 to atmosphere. When the set has stopped at position 0%, the user must place the magnetic tool in (S).

Step 2:
The positioner acts to send the valve/actuator set to the 100% position. Pressure at output 1 goes to its minimum value (atmosphere) and output 2 to maximum. When the set has stopped at 100% position, the user must place the magnetic tool in (S).

Step 3:
After adjusting the position reading gain, the set will be moved to the 0% position again. When the set has stopped at position 0%, the user must place the magnetic tool in (S).

Step 4:
Adjusts the other end of valve travel. No user action required.

NOTES
• The **MANUAL SETUP** is recommended in cases where it is not possible to execute the **AUTO SETUP** procedure due to very unstable environment. • The display will show messages informing the user of the need for intervention in steps 1, 2 and 3. If the user does not complete the action, the positioner will continue in the current step.

TRIM 4mA (Trim 4mA)
To calibrate the analog input signal, connect a variable current source (4 to 20 mA) to the positioner (+) and (-) terminals. To the follow steps the accuracy of the current source adjustment affects the position accuracy.
1. Adjust the current source to 4 mA (0%)
2. Place the magnetic tool in **S** to confirm. After DONE appears on the display, the trim will be done.

TRIM 20mA (Trim 20mA)
To calibrate the analog input signal, connect a variable current source (4 to 20 mA) to the positioner (+) and (-) terminals. To the follow steps the accuracy of the current source adjustment affects the position accuracy.
1. Adjust the current source to 20 mA (100%).
2. Place the magnetic tool in **S** to confirm. After DONE appears on the display, the trim will be done.

DISPLAY (Disp)
It configures which variable will be shown on the display during the normal operation of the equipment. The options are SP%**(SP)**, PV% **(POS)**, and MV%**(I-P)**.

ACTION (Act)
Direct acting **(di)** - output increases with increasing input signal.
Reverse acting **(rE)** - output decreases with increasing input signal.

CHARACTERIZATION - Characterization Curves (Char)
Select desired valve characteristic curve. The custom curve must have been entered through HART Interface.
- **Linear**: linear **(Lin)**
- **(EP25), (EP33), (EP50)**: equal percentage
- **(Hy25), (Hy33), (Hy50)**: hyperbolic (quick opening)
- **(tAb)**: table of 16 points (configurable)

MODE (Mode)
Determines the input mode of the setpoint. There are two modes:
- AUTOMATIC MODE (Auto)
The setpoint is determined by the input current.
- MANUAL MODE (man)
The setpoint is determined by the user.

SP % - SET POINT (SP)
This parameter represents the desired position value. In the “Manual” mode, this parameter may be changed by user, independently from the input current.

WARNING
• When turning the positioner off and on again, it automatically returns to AUTO (Auto Mode). • When the positioner goes from automatic to manual mode, it keeps the last setpoint value. • Be careful when the positioner switches from manual to automatic mode, as if the last user-defined setpoint value is too different from the input current, the valve will move abruptly.

TIME - SETPOINT VARIATION TIME (Time)
Determine the time, in seconds, required to move the valve from its fully open position to fully closed, or vice versa based on response parameters measured during the last AUTOTUNING or FULLSETUP procedures. Valid entries are 0 to 120 seconds. The value configured in the local adjustment will be unique and will be the possible opening/closing time.

Kp - PROPORTIONAL GAIN (KP)
Allows to adjust the proportional gain of the internal PID control.

Tr - INTEGRAL TIME (Tr)
Allows to adjust the integral time of the internal PID control.

Td - DERIVATIVE TIME (Td)
Allows to adjust the derivative time of the internal PID control.

FW VERSION (End)
It informs the installed firmware version, for example **V0.07**, and placing the magnetic tool in **S** exits the local adjustment.

Restore Factory Settings

Restoring the calibration returns the calibration parameters to their factory settings. After factory calibration is restored, the positioner must be recalibrated.

To restore the calibration to the factory settings, follow the steps below:

1. Disconnect electric power or a control signal of the positioner.
2. To access the local adjustment, loosen the screw and turn to the indication plate to side.
3. Holding down one magnetic tool on the hole marked with (Z) and other one on the hole marked with (S) simultaneously.
4. With the two magnetic tools in position, apply electric power or a control signal to the positioner.
5. After power on of the input signal, the FY500 initializes for a few seconds. After accomplished start, it factory settings will be restored.

Section 5

CONFIGURATION VIA HART®

The positioners may be connected in a point-to-point type or multidrop network. In a point-to-point connection, the equipment must be on "0". In a multidrop network, once the devices are recognized by their addresses, the positioners should be configured with a network address between "1" and "15".

If the acknowledgement is via tag, the positioners addresses may be on "0" and keep controlling the valve, even in a multidrop configuration.

NOTE

In case of a multidrop network configuration for classified areas, the entity parameters allowed for the area must be strictly observed. Therefore, the following should be checked:

$$Ca \geq \Sigma Ci_j + Cc \qquad La \geq \Sigma Li_j + Lc$$

$$Voc \leq min\ [Vmax_j] \qquad Isc \leq min\ [Imax_j]$$

Where:

Ca, La = Allowed Capacitance and Inductance on the bus;

Ci_j, Li_j = Non -protected internal Capacitance/Inductance of positioner *j (j = up to 15);*

Cc, ***Lc*** = Cable capacitance and Inductance;

V_{oc} = open circuit tension of the intrinsic safety barrier

I_{sc} = short circuit current of the intrinsic safety barrier

$Vmax_j$ = Maximum allowable voltage to be applied to the positioner *j;*

$Imax_j$ = Maximum allowable current to be applied to the instrument *j.*

The FY500 Valve Positioner includes a wide variety of HART command functions that makes it possible to access whatever functionality implemented on it. These commands work according to the HART protocol specifications and are grouped as Universal Commands, Common Practice Commands and Specific Commands.

For the user's safety the FY500 has two kinds of write protection in its memory, one hardware and the other a software mechanism. The hardware is selected by a H-H switch with priority over the software (See in the Section 4, Local Programming).

NOTE

The operation and use characteristics of each one of the configurators are in their specific manual. Consult the configurator updates and their respective manuals on http://www.smar.com or at their manufacturer.

Configuration Resources

By means of the HART® configurator, the FY500 firmware allows the following configuration features to be accessed; see below:

- Positioner Identification and Manufacturing Data;
- Remote Setpoint;
- Special valve characterization function according to a 16-point configurable curve;
- Flow characterization (Linear, Equal percentage and Quick opening);
- Monitoring of all device variables: position, setpoint, deviation and temperature;
- Positioner diagnostic, preventive maintenance, and failure determination;
- PID controller configuration;
- Device configuration;
- Device maintenance.

The configurator can be connected to the same pair of wires as the 4-20 mA signal, up to 2 kilometers away from the positioner.

Identification and Manufacturing Data

The following information about the **FY500** manufacturing and identification data is available:

TAG
8-character alphanumeric field for identification of the positioner.

DESCRIPTION
16-character alphanumeric field for additional identification of the positioner. May be used to identify service or location.

MESSAGE
32-character alphanumeric field for any other information, such as the name of the person who made the last calibration, some special care to be taken, or if a ladder is needed for physical access to the positioner.

DATE
The date may be used to identify a relevant date, such as the last calibration, the next calibration, or the installation. The date is stored in the American standard e.g.: Oct 16, 2022) and is automatically assumed after the choice of these items.

UNIQUE ID
Used to identify the device and in the construction of the HART long form address.

DEVICE INFORMATION
Allows to read the equipment identification data recorded in the factory.

NOTE
These items related to **EQUIPMENT INFORMATION**, engraved in the factory cannot be modified. They are read directly from the circuit memory.

Monitoring

This function allows remote monitoring of positioner variables. The time to start the reading is around 5 seconds. The values are always updated. Among others, some of the variables that can be monitored are: valve actual position in percentage, input in percentage of the adjusted current range (before the flow limits and linearization), input current in mA or %, device temperature in Celsius and in Fahrenheit degrees, etc.

Device Configuration

NOTE
WRITE PROTECTION – The configurator only shows that the writing is authorized if the **W1 jumper** from main board is connected to the pins over the word **ON** or if the protection is enabled by software.

Besides the equipment configuration and operation services, the **FY500** allows Auto Setup (Calibration) and Auto Tuning. See below the configuration options:

- **CHARACTERIZATION FUNCTION**
  This function can change valve flow characteristics. For example, if an equal percentage flow characterization is applied to a valve with linear flow characteristics, it will work as an equal percentage valve. Manufacturer documentation contains the valve inherent characteristic. The options for flow characterization are:

LINEAR	UNALTERED
Equal percentage	1:25
Equal percentage	1:33
Equal percentage	1:50
Quick opening	1:25 (Hyperbolic)
Quick opening	1:33 (Hyperbolic)
Quick opening	1:50 (Hyperbolic)
Table	16 pairs (X, Y)

- **DISPLAY**
  The FY500 digital display has three well-defined fields: information field with icons informing the active status of the configuration, 4 ½ numerical digit fields for value indication and alphanumeric field with 5-digit for status information and units. The parameters that can be selected for visualization are showed below:

PARAMETERS	DESCRIPTION
PV %	Process variable in percentage.
SP %	Setpoint in percentage.

- **TABLE CONFIGURATION**
  Through this button, a flow characterization curve with up to 16 points can be configured. This allows the construction of a special flow characterization curve, like linear combinations and equal percentage or other characterizations.

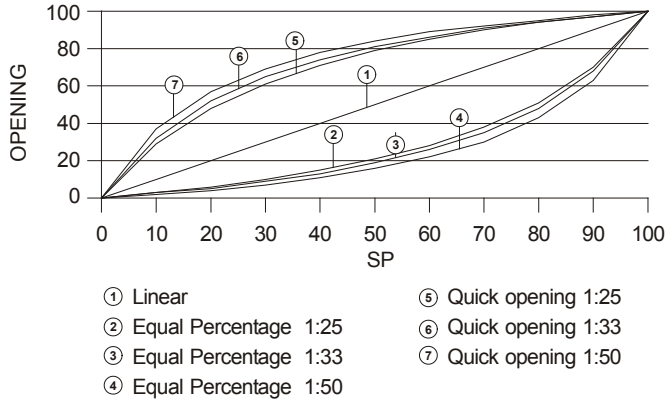

Table 5.1 - Valve Characteristic Curve

Advanced Configuration

This function affects valve advanced configurations. With advanced configuration it is possible to configure the valve type, if it is air-to-open or air-to-close, valve action, setpoint limits and split range.

Device Maintenance

This group includes maintenance services related to obtaining necessary information for the device maintenance and performance test. Some of the available services are: position adjustment and valve performance test, general information about the actuator and the valve, operations count, password level, code number model, performance and others.

Trim

There are two trim operations: current trim and temperature trim which can be performed by standard HART configurators.

- **CURRENT TRIM** allows to check the positioner input current reading. There are two types of current trims available:

  4 mA TRIM: is used to adjust the input current reading correspondent to 0%.
  20 mA TRIM: is used to adjust the input current reading correspondent to 100%.

- **TEMPERATURE TRIM** is the temperature reference for the positioner temperature sensor.

Automatic Configuration

This function allows to calibrate the valve travel automatically (Auto Setup and Auto Tuning), the points of the totally opened or totally closed stroke with higher precision (lower and higher position), to adjust the opening and closing times and the proportional, integral, and derivative actions of the PID (proportional, integral, derivative) control.

Multidrop Configuration

ADDRESSING
FY500 contains a variable that defines the device address in a HART network. HART addresses assume values from "0" to "15", the addresses "1" to "15" being specific addresses to multidrop connection. When the FY500 is configured for multidrop, it means that the display is showing “MD” and the address is a value from "1" to "15". FY500 is factory-configured with address "0".

Factory

This option is used only in the factory, and the user cannot access it.

Section 6

MAINTENANCE

General Information

NOTE
Equipment installed in hazardous areas must be inspected in compliance with the IEC60079-17 standard.

As a guarantee of quality, the FY500 Valve Positioners are extensively tested and inspected before delivery to the end user. Nevertheless, they were designed to provide an easy periodic cleaning and repair, when necessary.

It is recommended that the end user do not try to repair printed circuit boards. Instead, replace the pieces and, for this, the user should have spare circuit boards, which may be ordered from Smar whenever necessary.

The maintenance procedure is a set of techniques with the purpose of keeping the positioners with higher useful life, to operate in safe conditions and to promote costs reduction. The different types of maintenance are described during this section.

The positioner should be disassembled and undergo cleaning procedures, every time the final element of control is subject to maintenance.

Corrective Maintenance

Unplanned maintenance intends to locate and repair malfunction in the positioners or final elements of control operating in continuous work, or, specifically to suppress already existing defects.

Diagnostics are a set of methods to detect, to locate and eventually to correct errors and problems or even verify failures in the final element of control and in the positioner.

Preventive Maintenance

Planned Maintenance consists of a set of procedures and anticipated actions to keep the device functioning, in other words, mainly to prevent failures, through adjustments, proves and measures according to previously specified values. The preventive maintenance is recommended in the maximum period of one year, or when the process stops.

Diagnostics without HART interface

For a diagnostic without HART interface, perform the following steps.

1. Disconnect the supply pressure. Remove the restriction from I/P Converter Module. Visually check the orifice is clogged. For further information refer to Restriction topic.

2. Disconnect the supply pressure. Connect a 4-20 mA source to the positioner. Rotate the feedback shaft until the valve position reading changes to verify that the Hall sensor position reading is working. For further information refer to Electronic Module topic.

3. Connect the supply pressure to the (IN) port. Cover OUT1 port and OUT2 port with plugs.
   - Without electrical power connected, check if output port (OUT1) is zero and, output port (OUT2) goes to full supply air output. Refer to Transducer Module topic for further information.
   - Connect a 4-20 mA source to the positioner. Turn feedback shaft until cause changes in the outputs pressure. The outputs of a properly calibrated positioner will be in the saturated condition (zero pressure for OUT1 and fully supply for OUT2) or vice versa. Refer to

Transducer Module topic for further information.

To troubleshoot the FY500, refer to Table 6.1.

SYMPTOM	SOURCE / SOLUTION
INITIALIZING MODE – POSITIONER IS NOT POWERING UP	**Use a 4 to 20 mA current source to apply power to the positioner** Check input signal current. Minimum current for positioner operation is 3.8 mA. **Low control system compliance voltage** Check system compliance voltage. The voltage drop across the positioner is 9.5VDC while impedance is 475 ohms. **Positioner electrical connections** Check wiring polarity and continuity. **Electronic circuit failure** Check the electronic boards for malfunctions and replace them if necessary. **Defective terminal block** Check continuity from each screw terminal to the corresponding main board connector pin. Replace it if necessary.
VALVE POSITION READING IS NOT WHAT IS EXPECTED	**Low control system compliance voltage** Check system compliance voltage. The voltage drop across the positioner is 9.5VDC while impedance is 475 ohms. **Current leakage** Excessive moisture in the terminal block can cause current leakage. **Error occurred during calibration** Check instrument status on LCD display. Perform calibration.
NO RESPONSE FOR THE INPUT SIGNAL	**Air Supply Pressure** Low supply pressure. **Contamination of the pneumatic module** Check the spool valve for contamination (dirty air, oil, dust, etc.). **Contamination of the I/P Converter Module** Check the nozzle-flapper for contamination. **Clogged Restriction** Check the orifice for contamination. **Error occurred during calibration** Check instrument status on LCD display. Perform calibration. **Wrong air MODE entered in software** Check MODE in manual. Set the MODE to AUTO.
OPERATION INSTABILITY OR POSITIONER OSCILLATION	**Feedback arm or rotary adaptor bent/damage** Check for excessive play in the linkage and correct. **Control tuning parameters are not correct** Perform calibration. **Contamination of the I/P Converter Module** Check the nozzle-flapper for contamination.
POSITIONT IS DRIVEN FULLY OPEN OR CLOSE AND WILL NOT RESPOND TO COMMAND	**Stroke not calibrated** Perform calibration. **Actuator tubing backward** Check air to open/air to close actuator tubing.

Table 6.1 - FY500 - Diagnostics Without Configurator

Diagnostics with HART Interface

For diagnostic with HART interface, perform the following steps.

1. Connect a variable 4-20 mA source to the positioner. Communicates with HART interface.

2. The current signal is the signal to the I/P Converter Module from the analog board. It is the percentage of the microprocessor signal needed to drive the valve fully open. Verify the current signal (40 to 60%) with the valve off the stops. Replace I/P Converter Module if drive signal is continuously high or low. I/P Converter Module may have been adjusted. For further information refer to I/P Converter Module topic**.**

3. The Hall sensor displays the actual position of the valve. It is absolute number of feedback signal from Hall sensor (0 to 65000). Verify the Hall value (28000 to 37000) with the valve on 50% position (middle travel). If the sensed travel is outside the range of calibrated travel, check the mounting and the travel sensor adjustment. Also, check that the electrical connection from the Hall sensor is properly plugged into the analog board. After restarting the positioner, if the problem does not clear, troubleshooting the Connection Module. For further information refer to I/P Connection Module topic.

Error Messages

The error messages inform which diagnostics were found through errors and malfunctioning self-diagnosis. When the configurator is communicating with the positioner, the user is informed on any problem found, through the self-diagnosis. At the FY500 positioner, the error messages always alternate with the information on the top line of the interface display. The next table lists the error messages and more details on the corrective action.

STATUS	POTENTIAL SOURCE
PARITY ERROR	• Excessive noise or ripple in the line. • Low level signal. • Damaged interface • Power supply or battery voltage of the configurator lower than 9 V.
OVERRUN ERROR	
CHECK SUM ERROR	
FRAMING ERROR	
BUSY LINE	• Other device using the line.
CMD NOT IMPLEMENTED	• Software version not compatible between configurator and positioner.
BUSY DEVICE	• Positioner carrying out an important task, e.g., local adjustment.
POSITIONER MALFUNCTION	• Disconnected transducer. • Transducer with damage. • Stuck valve.
COLD START-UP	• Start-up or power supply failure.
FIXED OUTPUT	• Operating in local mode with fixed position.
NO RESPONSE	• Positioner line resistance is not according to technical characteristics. • Positioner without power supply. • Interface disconnected or damaged. • • When in multidrop mode, check if the positioner is looking for the device at the address where it is configured. • Interface damaged. • Power supply or battery voltage of the configurator lower than 9 V.

Table 6.2 – FY500 Diagnostics with the Configurator

Electronic Housing Module

The main electronic board contains the circuit board that perform control functions of the positioner. The main board is to be replaced as a unit. None of its components can be repaired.

WARNING
Observe precautions for handling electrostatically sensitive devices.

Removing Electronic Housing Module

To remove the electronic housing module, perform the following steps, refer to figure 6.1.

1. Disconnect electric power and supply pressure from the positioner.
2. Loose the cover locking screw and remove the cover.
3. Being careful not to lose the nylon washer, loosen the two captive main board screws.
4. Pull the main board straight out of the electronic housing. One clear of the housing, swing the main board to the side of the housing to gain access to the cable assemblies.
5. The electronic housing has two cable assemblies, which connect the terminal block to the main board. Disconnect these cable assemblies from the main board.
6. The transducer module has one flat cable, which connect the analog board to the main board. Disconnect this flat cable from the main electronic board.
7. Loose the rotation locking screw.
8. Being careful not to twist the flat cable. Carefully loosen the electronic housing from the transducer module by turning it to unscrew.
9. Remove the electronic housing and inspect the O-ring. Replace it if necessary.

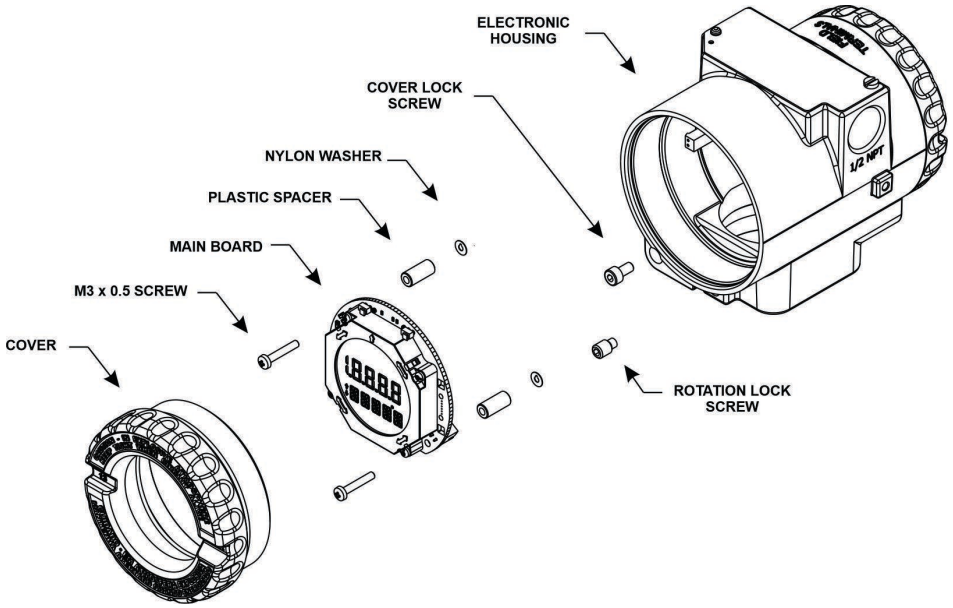

Figure 6.1 – Electronic housing

Replacing Electronic Housing Module

To replace the electronic housing, perform the following steps, refer to **figure 6.1**.

1. Ensure the O-ring is properly installed on the connection module.
2. Being careful not to twist the flat cable. Replace and screw the electronic housing into the transducer module.
3. Tighten the rotation locking screw.
4. Connect the ribbon cable from the transducer module. Orientation of the connector is required.
5. Connect the two cable assemblies to the main electronic board. Orientation of the connectors are required.
6. Replace the main electronic board into the electronic housing. Tighten the two captive screws.

Transducer Module

The transducer module contains the following submodules: **Connection**, **I/P Converter**, **Diaphragm**, **Pneumatic** and **Feedback**. As shown in Figure 6.2.

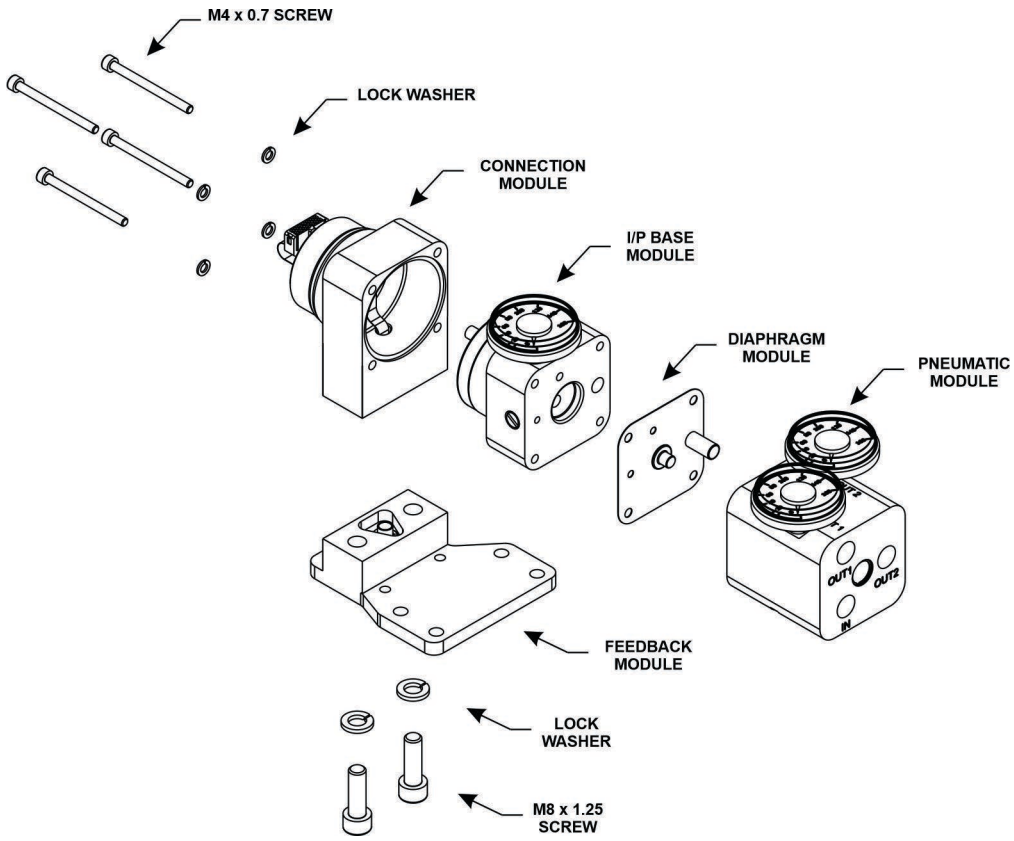

Figure 6.2 – Transducer Module

Connection Module

The Connection Module contains the analog board and the sensor board. The input signal from the main board arrives to the analog board through a flat cable. It is converted to a current signal by the I/P Converter Module. The stem position is sensed through the feedback module by the Hall sensor on the sensor board. The feedback signal from the sensor board is routed into the analog board through a cable assembly.

WARNING
Observe precautions for handling electrostatically sensitive devices.

Removing the Connection Module

To remove the connection module, perform the following steps, refer to figure 6.2.

1. Loosen the four M4 x 0.7 hex head screws.
2. Pull the connection module straight out of the I/P Converter Module. Be careful not to damage the two electrical wires that come out of the I/P Converter Module. Check if the flat cable is not twisted, broken, or oxidized.

Replacing the Connection Module

To replace the Connection Module, perform the following steps, refer to figure 6.2.

1. Install the I/P converter module directly into the connection module, taking care that the two

electrical wires enter the I/P converter guides. These guides route the wires to the analog board.
2. Tighten the four M4 x 0.7 hex head screws.

I/P Converter Module

The I/P Converter Module receives a current signal from analog board and converts it to pneumatic signal to the Diaphragm Module. The analog board determine how much current to send to the coil for a desired pressure signal. The electromagnet field varies the nozzle-flapper spacing, which regulates the I/P output pneumatic signal.

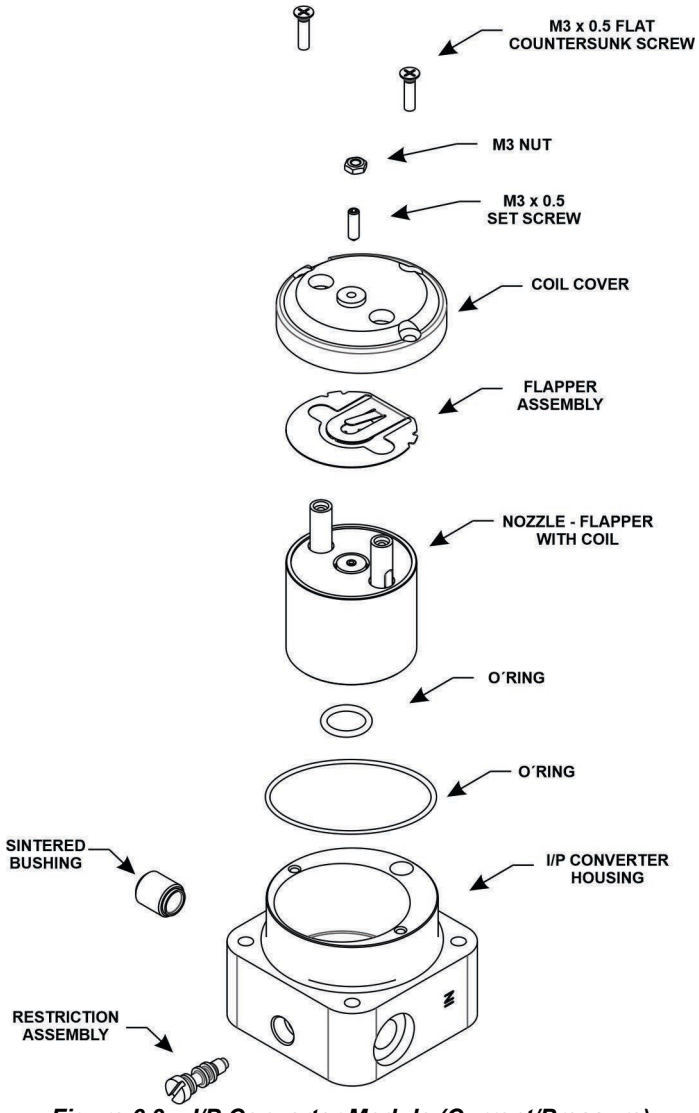

Figure 6.3 – I/P Converter Module (Current/Pressure)

Disassembling Nozzle-Flapper with Coil

To disassemble the Nozzle-Flapper with Coil, perform the following steps, refer to Figure 6.3.

1. 1. Remove the two countersunk head screws (Philips) that attach the coil cover to base.
2. Pull the coil cover straight out of base.
3. Remove the flapper assembly. Check for bent flapper, contamination, or dirty air supply. The flapper can be cleaned with a non-residue cleaner, lint free cloth and soft bristle brush.
4. Remove the nozzle-flapper with coil. Check for open coil (continuity), contamination, or dirty air supply. Coil resistance should be between 1900 to 2100 ohms.

Adjusting Nozzle-Flapper with Coil

To adjust the Nozzle-Flapper with Coil, perform the following steps.

1. Install the I/P Converter Module into the FYCAL base.
2. Install the four screws and evenly tighten.
3. Regulate the supply pressure to the I/P Converter. Regulated pressure should be between 23 to 25 psi.
4. Observe the pressure indicated by the output pressure gauge. The pressure should be between 1.8 to 2.2 psi.
5. To adjust the pneumatic signal, loose the M3 nut and turn the set screw until the pressure indicated on the pressure gauge is 1.8 to 2.0 psi. Tight the nut.
6. Connect the positive wire of the FYCAL to the positive coil receptacle (+) and the negative wire of the FYCAL to the negative coil receptacle (–).
7. Apply 4 mA to the input. Check if the pneumatic signal 15 psi or more.
8. Apply 0 mA to the input. Check if the pneumatic signal is 1.8 to 2.2 psi. The current may affect the adjustment.
9. Repeat steps 5, 6, 7, and 8 until the proper adjustments are obtained.

For more information, refer to the FYCAL manual.

Restriction

The restriction has a small orifice that restricts the flow and air consumption of the air from an internal pressure regulator.

To check the restriction, perform the following steps, refer to figure 6.4.

1. Remove the restriction from the I/P Converter Module.
2. Remove the O-ring with an appropriate tool.

3. Visually verify if the orifice is clogged. If is clogged, dive the part in petroleum base solvent and dry it with dry compressed air (apply the compressed air directly in the smaller orifice for the air to get out through the bigger orifice).
4. Insert the cleaning needle (Code 400-0726) into the restriction hole to prevent any possible obstructions. Take care not to make the orifice larger during cleaning; or positioner performance will be affected.
5. Inspect the O-rings for wear. Replace O-rings.
6. Tightly the Restriction into the I/P Converter Module.

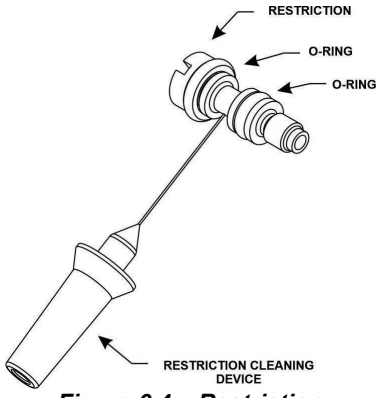

Figure 6.4 – Restriction

Sintered Bushing

The sintered bushing incorporates a filter element in a two-piece bushing. This protects the nozzle-flapper with coil chamber from a moisture and it is exhaust output. To check the sintered bushing, perform the following steps, refer to Figure 6.3.

1. Remove the sintered bushing.
2. Check for contamination or dirty air supply. Replace if necessary.
3. Reinstall the sintered bushing.

Diaphragm Module

The Diaphragm Module receives the signal pressure from nozzle-flapper.

To check the Diaphragm, perform steps, refer to figure 6.2.

1. Remove the Diaphragm Module.
2. Ensure the Diaphragm Module is in good condition. Do not reuse a damage or worn Diaphragm Module. The diaphragm can be cleaned with a non-residue cleaner, lint free cloth and soft bristle brush.
3. When replacing the Diaphragm Module make sure all passages and screw holes are aligned. Place the Diaphragm Module on the I/P Converter Module.

Pneumatic Module

The air passes through an internal pressure regulator that regulates the pressure to approximately 24 psi. The spool valve is also connected to supply pressure and provides two output pressures. The pneumatic signal moves the Diaphragm Module, pushing the spool valve. This opens the spool valve ports.

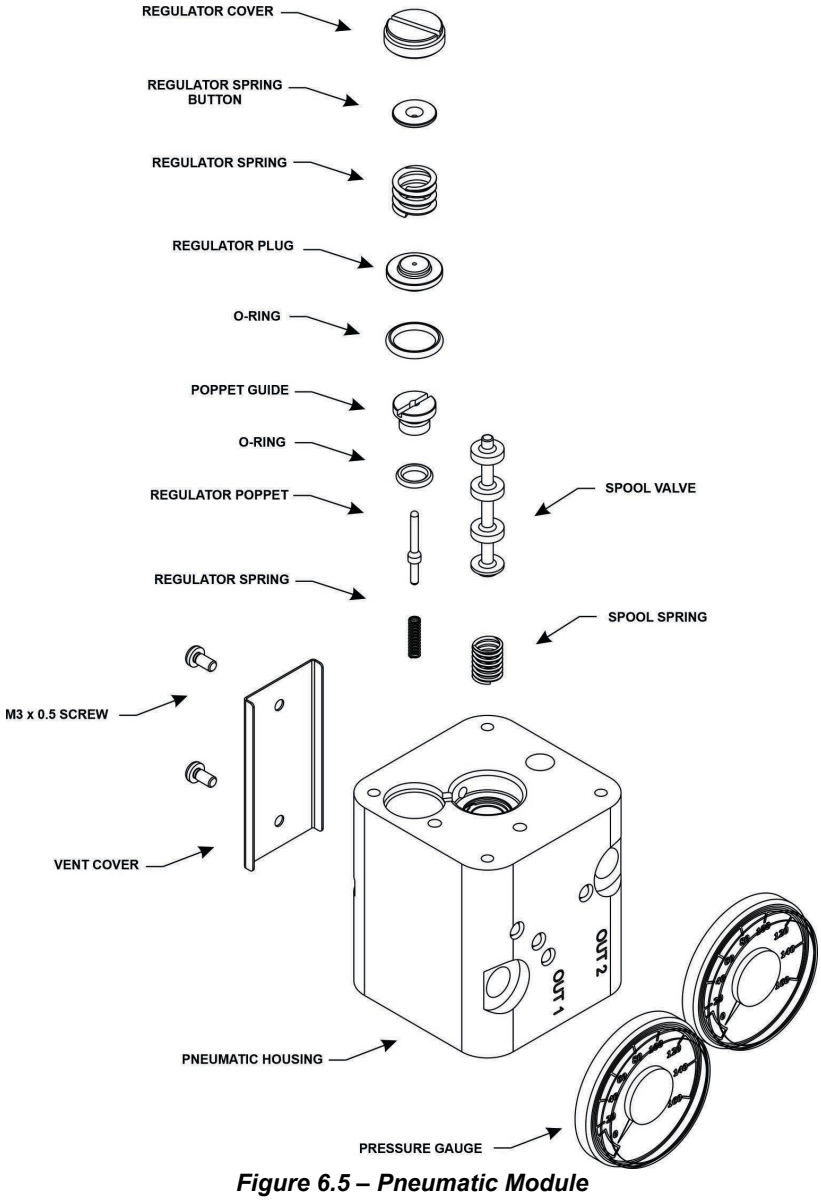

Figure 6.5 – Pneumatic Module

Pressure Regulator

To disassemble the Pressure Regulator, perform the following steps, refer to Figure 6.5.

1. Using a flat screwdriver, remove the regulator cover.
2. Remove the regulator spring button and the regulator spring.
3. Remove the regulator plug and its o-ring.
4. Using a flat screwdriver, remove the poppet guide, its O-ring, the regulator poppet, and the regulator spring.
5. The regulator cavity can be cleaned with a non-residue cleaner, lint free cloth and soft bristle brush.

To assemble the Pressure Regulator, perform the following steps, refer to Figure 6.5.

1. Place the regulator spring and regulator poppet into the housing cavity.
2. Place the poppet guide O-ring on the poppet guide and insert the regulator poppet through the bottom of the poppet guide. Screw the poppet guide into the housing being careful not to over tighten. A maximum torque of 4 to 5 inch-pounds is sufficient. Make sure the poppet is free to move up and down and has spring load.
3. Being careful to push the O-ring into the bore.
4. Place the regulator plug into the bore.
5. Place the regulator spring on the regulator plug, and then place the regulator spring button on the spring.
6. Place a small amount of thread locking compound on the regulator cover and screw into the housing.
7. Position the regulator cover leaving approximately 2 mm of the pneumatic housing surface.

Spool Valve

The spool valve will apport supply to the actuator. An increase in the loop control signal causes the pneumatic signal increase, pushing the spool and, by means of the pneumatic signal, change the output pressures and flow rate. This will cause the actuator stem movement.

WARNING
Never use oil or lubricant on the spool valve, otherwise the positioner performance will be impaired.

To check the Spool Valve, perform the following steps, refer to Figure 6.5.

1. Remove the spool valve and its spring.
2. Check for scratches, contamination, or dirty air supply. To operate properly, the spool should slide freely and fall through by its own weight when held vertically.

3. The valve spool and the spool cavity can be cleaned with a non-residue cleaner, lint free cloth and soft bristle brush. Blow out all pneumatic connections to prevent dirt, chips, or debris from entering the housing.
4. Place the spool spring and the spool valve into the housing. Do not use any oil or lubricant.

Vent Cover

The Vent Cover incorporates a filter element in a two-piece cover. This protects the spool valve chamber from moisture and provides protection against exhaust air from the spool valve.

To check the Vent Cover, perform the following steps, refer to Figure 6.5.

4. Remove the vent cover.
5. Check for contamination or dirty air supply. Replace it if necessary.
6. Reinstall the vent cover.

Feedback Module

The Feedback Module transmits valve position to analog board. This is accomplished by means of a Hall sensor that connects to the valve stem through a feedback linkage.

To check the Feedback Module, perform the following steps, refer to Figure 6.2.

1. Loosen the two M8 x 1.25 hex head screws. Remove the Feedback Module.
2. Work shaft by hand, make sure that the shaft moves freely. Replace it if necessary.
3. Reinstall the Feedback Module.

Package Content

Verify the package content. The items marked with (*) must be in accordance with the number of positioners supplied.

- Positioner
- Mounting Bracket with Screws (linear or rotary)
- Restriction Cleaning device (*)
- Instructions Manual (*)

Accessories

ACCESSORIES	
ORDERING CODE	**DESCRIPTIONS**
SD-1	Magnetic tool for configuration via local adjustment.
400-0726	Restriction Cleaning needle.

Exploded View

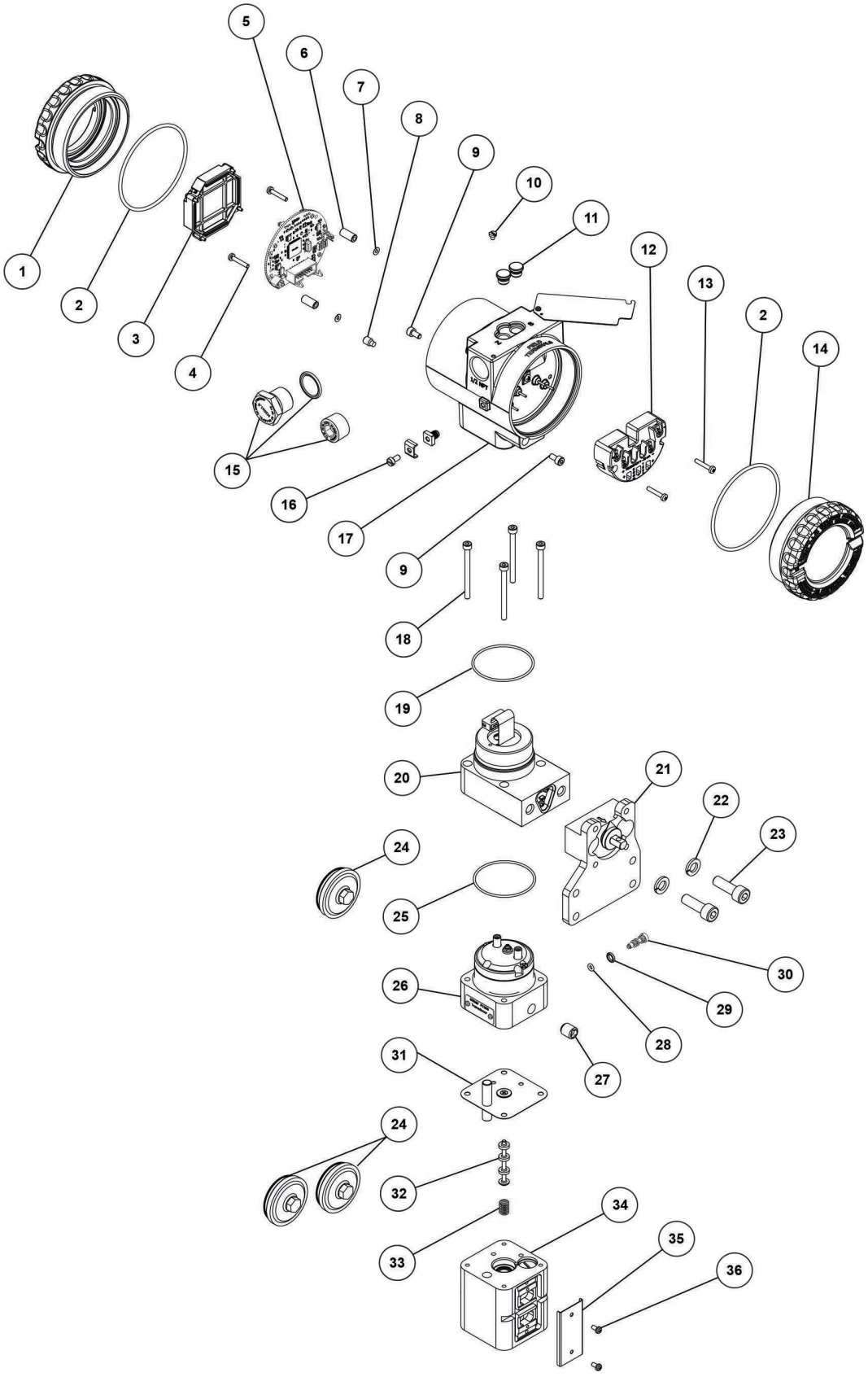

Figure 6.6 – Exploded View

Spare Parts

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CODE**	**CATEGORY (NOTE 4)**
HOUSING (NOTE 1)	17	400-1314-8 (NOTE 6)	-
COVER WITH WINDOW (INCLUDES O-RING)	1	400-0822 (NOTE 6)	-
COVER WITHOUT WINDOW (INCLUDES O-RING)	14	400-1257 (NOTE 6)	-
Cover Locking Bolt	9	204-0120	-
Sensor Locking Bolt (M6 Set Screw)	8	400-1121	-
External Ground Bolt	16	204-0116	-
Identification Plate Fixing Bolt	10	204-0122	-
O-rings Cover (NOTE 2)	2	204-0124	B
Local Adjustment Protection Cover	11	204-0114	-
MAIN ELECTRONIC CIRCUIT BOARD GLL1480 (include digital indicator and mounting kit)	5	400-1511	A
DIGITAL INDICATOR (Display) (include fixing screws)	3	400-1512	A
MOUNTING KIT FOR MAIN ELECTRONIC BOARD (2 bolts with spacers and retention washers)	4, 6, and 7	400-0560	B
TERMINAL INSULATOR FOR 4-20mA POSITION FEEDBACK	12	400-1329	A
TERMINAL BLOCK INSULATOR FIXING SCREW	13	204-0119	
CONNECTION COVER	18, 19, and 20	400-1508 (NOTE 6)	A
. Connection Cover Bolt	18	400-0073	-
. Buna-N Neck O-ring (NOTE 2)	19	204-0113	B
FEEDBACK MODULE	21, 22, and 23	400-1509 (NOTE 6)	A
Two M8 hex head screw and lock washer	21 and 23	400-1519	-
COIL BASE SET	24, 25, 26, 27, 28, 29, and 30	400-1507 (NOTA 6)	A
. Block O-ring (NOTE 2)	26	400-0915	B
. Restriction	30	344-0165	B
. Restriction External O-ring (NOTE 2)	29	344-0155	B
. Restriction Internal O-ring (NOTE 2)	28	344-0150	B
. Sintered Bushing	27	400-0033	B
. Pressure gauge (Stainless Steel and Brass) (NOTE 5)	24	400-1120	B
ASSEMBLED DIAPHRAGM (include hall tube)	31	400-1513	B
PNEUMATIC MODULE	24, 32,33, 34, 35, and 36	400-1505 (NOTE 6)	A
. Pressure gauge (Stainless Steel and Brass) (NOTE 5)	24	400-1120	B
. Spool valve	32	400-1514	B
. Spool valve Spring	33	400-1515	-
. Vent cover - Stainless Steel (included 2 bolts)	35 and 36	400-1516	-
1/2" NPT INTERNAL HEXAGONAL PLUG SST316 BR-Ex-d	15	400-1484 (NOTE 7)	-
M20 X 1.5 (Ex d) HEX HEAD PLUG IN 316 SST	15	400-0810	-
PG13.5 (Ex d) HEX HEAD PLUG IN 316 SST	15	400-0811	-
3/4" NPT (Ex d) ADAPTER IN 316 SST	15	400-0812	-
TRANSDUCER SET	NOTE 3	400-1506 (NOTE 6)	A
VALVE ACTUATOR MOUNTING BRACKET			
Rotary	-	400-1510-1	-
Linear Stroke 12 to 20 mm	-	400-1510-2	-
Linear Stroke 20 to 60 mm	-	400-1510-3	-
Linear Stroke 60 to 120 mm	-	400-1510-4	-
Linear Stroke 120 to 200 mm	-	400-1510-5	-

SPARE PARTS LIST			
PARTS DESCRIPTION	**POSITION**	**CODE**	**CATEGORY (NOTE 4)**
POSITIONER MOUNTING BRACKET			
Linear (contains screws and washers (packaged with 12 units)	-	400-1517	-
Rotary (contains screws and washers (packaged with 12 units)	-	400-1518	-

NOTES

1) Includes terminal isolator, bolts (cover locking, ground, and terminal isolator) and identification plate without certification.
2) O-rings are packaged with 12 units.
3) Includes all transducer's spare parts.
4) For category **A** it is recommended to keep in stock 25 parts installed for each set and 50 for category **B**.
5) The pressure gauges for supply pressure, output 1 or output 2, will be supplied with the wet parts in brass.
6) To specify, use the DETAILED CODE FOR ORDERING SPARE PARTS tables. See tables below.
7) The spare part 400-1484, Internal Hexagonal Plug 1/2" NPT SST316 BR-Ex-d, was standardized in SST316 material and will be used in all line of housings (aluminum or SST316). With or without certification.

Detailed Code for Ordering Spare Parts

CODE	DESCRIPTION
400-1314-8	**Housing; FY500**
Option	**Communication Protocol**
H	HART & 4-20 mA
Option	**Electrical Connection**
0	½ NPT
A	M20 X 1.5
B	PG13.5
Option	**Material**
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)
H2	Aluminum - for saline atmospheres (IPW/Type X)
H3	Aluminum Copper Free (IPW/Type X)
Option	**Painting**
P0	Gray Munsell N 6,5
P8	Without Painting

400-1314-8	*	*	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-0822	**Cover with window; FY500**
Option	**Material**
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)
Option	**Painting**
P0	Gray Munsell N 6,5
P8	Without Painting

400-0822	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-1257	**Cover without window; FY500**
Option	**Material**
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)
Option	**Painting**
P0	Gray Munsell N 6,5
P8	Without Painting

400-1257	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-1506	Transducer Set; FY500

Option	Indication Gauge
0	Without gauge
6	01 Gauge - Input
7	01 Gauge – Output 1
8	02 Gauge – Input and Output 1
9	02 Gauge – Output 1 and 2
A	03 Gauge

Option	Action of Positioner
C	Single Action
D	Double Action

Option	Material
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)

Option	Painting
P0	Gray Munsell N6.5
P8	Without Painting

Option	Mounting Version
R0	Integral Mounting

400-1506	*	*	*	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-1505	Pneumatic Module; FY500

Option	Indication Gauge
0	Without gauge
7	01 gauge – Output 1
9	02 gauges – Outputs 1 and 2

Option	Action of Positioner
C	Single Action
D	Double Action

Option	Material
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)

Option	Painting
P0	Gray Munsell N6.5
P8	Without Painting

400-1505	*	*	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-1507	Coil Base Set; FY500

Option	Indication Gauge
0	Without Gauge
6	01 Gauge - Input

Option	Material
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)

Option	Painting
P0	Gray Munsell N6.5
P8	Without Painting

400-1507	*	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-1508	**Connection cover; FY500**

Option	Material
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)

Option	Painting
P0	Gray Munsell N6.5
P8	Without Painting

400-1508	*	*	**TYPICAL ORDERING CODE**

CODE	DESCRIPTION
400-1509	**Feedback Module; FY500**

Option	Material
H0	Aluminum (IP/Type)
H1	Stainless Steel (IP/Type)

Option	Painting
P0	Gray Munsell N6.5
P8	Without Painting

400-1509	*	*	**TYPICAL ORDERING CODE**